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ABSTRACT

A project was conducted to field test selected first- and second-year courses in a postsecondary nuclear quality assurance/quality control (QA/QC) technician curriculum and to develop the teaching/learning modules for seven technical specialty courses remaining in the QA/QC technician curriculum. The field testing phase of the project involved the collection of (1) achievement data from the students (trainees), (2) academic and prior experience data from the students, and (3) curriculum evaluative data from the students and instructors. Seven modules were revised based on field testing data gathered at six test sites. In addition, the following seven specialty courses were developed for use in the second year of the nuclear QA/QC technician curriculum: nondestructive examination techniques I, metrology, welding inspection, civil/structural inspection, mechanical inspection, quality assurance practices, and nondestructive examination techniques II. A total of fifty-three modules were developed for the seven specialty courses. (Appended material includes the revised field test plan, the final revised field test plan, a listing of field test sites, statistical data on the pretest and posttest used for field testing, and a list of the course modules and objectives.) (LRA)

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FINAL REPORT

DEVELOPMENT AND FIELD TESTING OF A NUCLEAR QUALITY ASSURANCE/QUALITY CONTROL TECHNICIAN CURRICULUM

for

Department of Health, Education and Welfare
Office of Education

Contract Number 300770340

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I. INTRODUCTION

The Department of Health, Education and Welfare (DHEW), Office of Education has placed special emphasis on the development of curricula for new and changing occupations. A previous project designed to identify new and emerging occupations revealed the Nuclear Quality Assurance/Quality Control (QA/QC) Technician as a new occupation resulting from the industrial application of nuclear technology. It was initially determined that this technician would perform quality control tasks required by the Code of Federal Regulations to minimize the potential hazards to the health and safety of the public resulting from nuclear power plant design, construction and operation. DHEW determined that curriculum materials should be developed for QA/QC Technician training programs.

General Physics Croproation (GPC) sought to undertake the project described in this report because of a first-hand understanding of the needs for the curriculum development, evaluation and promotion efforts outlined in the DHEW Request for Proposal, RFP-77-36, dated April 1, 1977. It was recognized that a vital role could be played by local community and junior colleges, technical institutes and university extensions in preparing individuals for employment in this new and growing field.

In August, 1977, General Physics Corporation was awarded the contract to develop the second-year courses and to field test selected first and second-year courses in the Nuclear QA/QC Technician curriculum.

During the preparation of the proposal for this contract, General Physics delineated three statements of project objectives that guided the labors of the staff in the completion of all tasks specified in the proposal. For each objective, an outcome statement was prepared to serve as a bench mark of progress and successful completion of these various tasks. Table 1 presents the three objectives and outcome statements.

Table 1 - Objectives and Outcomes for the
Nuclear QA/QC Technicain Curriculum

A. To conduct a summative field test of seven courses and their modules in the Nuclear Quality Assurance/Quality Control Technician curriculum for the purpose of gaining information; to improve the courses and their modules to determine the extent to which students achieve the objectives of the courses and the modules; and to revise the courses and modules based on the field test results.	A. Completion of a set of revised modules that will gain universal acceptance in the Nuclear Industry and will be widely utilized for producing highly skilled Nuclear QA/QC technicians who can confidently accept this important role in the industry. The result of which is greater reactor safety and properly verified nuclear power plant systems and safeguards.
B. To develop the teaching/learning modules for seven technical specialty courses remaining in the Quality Assurance/Quality Control Technician curriculum.	B. Completion of the remaining set of courses which are organized around clear objectives which contain the necessary information beneficial for the accomplishment of Nuclear QA/QC tasks in the post-learning environment (the nuclear industry).
C. To familiarize educational institution, industry and related personnel with the Nuclear Quality Assurance/ Quality Control and the Nuclear Reactor Operator (Trainee) curricula.	C. To properly acquaint all necessary industry personnel and pertinent educational institutions of the QA/QC curriculum through an aggessive promotional campaign. The result of which is universal usage of this curriculum by those technical schools and nuclear utilities in the training of Nuclear QA/QC Technicians.

The field testing of six first year courses and one second year course is described in Section II of this report. The development of the 53 instructional modules comprising the seven second year courses is described in Section III of this report. The final section of this report describes the efforts which were undertaken to familiarize appropriate individuals with these curriculum materials.

II. FIELD TESTING

A. Introduction

At the beginning of the project, a preliminary study of the acceptability of the materials to be field tested was conducted. This study solicited reactions from instructors, a sample of nuclear industry representatives, and a small number of curriculum design specialists. Some initial delay was experienced as a result of the unavailability of the courses to be field tested during the first few months of this project. This delay affected the original timetable for the conduct of the project. As a result of this acceptability study, minor revisions were made in the course materials received by General Physics Corporation (GPC). In addition, the posttests that accompanied the course materials were rewritten so as to be equivalent in form and content with the objective pretests that were produced by GPC for purposes of field testing. Further delay was experienced as a result of some misunderstandings concerning the course materials initially delivered to GPC. The materials received after the award of the contract were not the revised versions that were produced under a previous contract funded by the Department of Health, Education, and Welfare (DHEW). Upon receipt of the revised course materials, all pretests and posttests were rewritten to reflect the objectives and content of those versions of the course materials which were to be field tested. This had an additional impact on the project schedule as well as the effort required for pretest and posttest construction.

B. Construction of Pretests and Posttests

Each module received by GPC after the contract award contained a posttest. However, without exception, these posttests were judged to be unacceptable in their original form for use in a field test because of the primarily subjective format used for the tests. Although the items fit the stated objectives for the modules, in many cases the objectives were not written in true behavioral terms providing appropriate indicators of student attainment and acceptable standards for successful attainment of the objective. Reliable measures of student achievement could not be obtained from the original module posttests.

Initially, each module posttest was carefully reviewed and where necessary each item was rewritten in an objective format. The intent was to construct items whose answers could be reliably scored by the instructors. When the posttests for all of the modules of a course were rewritten, a course pretest was constructed by taking a sample of the items from each module posttest. The number of items taken from the posttests was limited by the need to construct a pretest that could be completed by the students (trainees) in about 45 minutes and by the number of items on the posttests. The procedure was repeated for each of the courses to be field tested.

Thus, each pretest consisted of a set of subtests each of which was composed of a subset of items from a module posttest.

C. Field Test Plan

The tentative field test plan contained in the GPC proposal was revised and presented to the DHEW contract officer for approval. This revised plan was designed to serve the interests of the Office of Education and the interests of the nuclear industries. These interests were represented by three broad goals for field testing:

- To assess the feasibility and acceptability to instructors, students, educational institutions and industries of this set of modules for technical education programs in QA/QC.
- To obtain information which would aid selective post-field test revision of the modules.
- To obtain information that would aid in the formative process in the development of 49 additional modules for technical education in the nuclear field.

The revised field test plan as developed by General Physics (see Appendix A) called for the collection of (1) achievement data from the students (trainees); (2) academic background and prior experience data from the students (trainees) and the instructors; and (3) curriculum evaluative data from the students (trainees) and the instructors.

Achievement data would be collected via course pretests and module posttests for each module of the course. The primary purpose of this data was to enable GPC to measure the pretest-posttest gain and use that measure to help assess the acceptability of the modules.

The collection of academic background and prior experience information was proposed as a means to establish the overall characteristics of each class participating in the field test providing a background for interpreting other data obtained. This information would be gathered using the "Instructor Academic Background and Prior Experience Survey" and the "Student (Trainee) Academic Background and Prior Experience Survey" forms.

Curriculum evaluative data was deemed essential for the effective revision of the course modules. Input would be solicited from both students (trainees) and instructors using the "Instructor Course Evaluation" and "Student Course Evaluation" forms to be completed at the conclusion of each course. Additonal feedback from the students (trainees) would be provided by using a special format for the module booklets. Each page of the booklets would contain a tear-out section for the students (trainees) to use to write comments concerning the materials as they worked through them (Open-ended Comment Procedure). The instructors would provide additional input through the use of the "Instruction Module Evaluation" form to be completed at the conclusion of each module.

The revised field test plan was structured to allow a course by course implementation providing maximum flexibility for utilization of field test sites. At the time the revised plan was submitted to DHEW, General Physics had a firm committment from one site to field test all seven courses and expressions of interest in participating in the field test from seven other post-secondary institutions and three public utilities.

The revised plan was submitted to the DHEW project officer on October 17, 1977. The project officer gave verbal instructions on December 12, 1977, that those portions of the field test plan requiring use of forms to be approved by OMB should be deleted. Accordingly, all such forms were deleted. This resulted in substantial modification of the field test plan.

The final revised plan (see Appendix B) provided for collection of (1) background data from the instructors using the "Instructor Academic Background and Prior Experience Survey" form; (2) achievement data from the students (trainees) in the form of course pretests and module posttests; (3) curriculum evaluative data from the instructors for each module and course using the "Instructor Module Evaluation" and "Instructor Course Evaluation" forms; and (4) curriculum evaluative data from the students in the form of notes taken by the instructor during an open discussion by the students concerning the quality of the curriculum materials and recorded on the "Post Course Class Discussion of Curriculum Materials" form.

After the selection of field test sites, the implementation of the field test at each site proceeded through several distinct stages. Initially, the instructors were provided with all of the materials needed for the field test including module booklets, pretests, posttests, evaluation forms, and all necessary instructions. After the instructors had sufficient time to review the materials, GPC contacted the instructors through a site visit and/or telephone conversations for a final briefing prior to student involvement. The actual test of the materials began with the signing of data release forms by the students (trainees) and the administration of the pretest. Following the pretest, the class worked through the materials at a pace determined by the instructor. The students took a posttest and the instructors completed an "Instructor Module Evaluation" form at the conclusion of each module. Pretests and posttests were scored by the instructors and returned to GPC. At the conclusion of the course, an open discussion of the curriculum materials was held and the instructor recorded the results on the "Post Course Class Discussion of Curriculum Materials" form. In addition, the instructor completed an "Instructor Course Evaluation" form. All forms were then returned to GPC.

D. Field Test Site Selection

At the time of the writing of the proposal for this project, GPC had obtained statements of genuine interest and willingness of participate in the field testing activites from four sites. When the revised field test plan was submitted to DHEW in October 1977, one site was firmly committed to test all seven courses and 10 other sites were still interested in participating in the field test.

However, the actual timing of the startup of this project coupled with the delays described earlier in this report resulted in some difficulties with the site selection process. Several schools were reluctant to make commitments in the middle of the school year. The amount of effort required in soliciting agreement to field test modules and the number of organizations which withdrew support of the project far exceeded any reasonable expectations. Of the four sites who originally tentatively agreed to participate in the field test, only one site agreed to conduct field testing after reviewing the modules. A major setback occurred in June, 1978 when another institution which had agreed to field test all seven courses withdrew its committment after conducting only one course. Additional setbacks occurred in January 1979 when another institution withdrew its offer to field test Course #3, and in February 1979 when yet another institution withdrew its committment to field test Course #27.

One site committed to field test Course 11 actually tested only two modules of that course. The additional modules were scheduled to be included with those of Course 14 during a subsequent academic quarter. However, the remaining modules from Course 11 were not used in the subsequent quarter and the instructor elected to not give the pretest for Course 14.

Finally, a public utility site which remained committed to test all seven courses throughout the period of the contract was able to complete only three of the courses by the end of August 1979. A listing of other institutions and utilities which declined to participate in the field test is presented in Appendix C. It should be noted that at several times during the project, GPC had committments to test each of the seven courses at three different sites.

In addition to the above problems, fewer institutions than anticipated were found to have a curriculum suitable for field testing the seven courses. Of those with established nuclear programs, most declined to participate in the field testing because they were satisfied with their existing programs. GPC contacted every post-secondary institution on the lists of institutions with nuclear technology programs and institutions anticipating nuclear technology programs supplied by DHEW. In addition, GPC contacted many additional institutions and public utilities searching for possible field test sites.

The net result was that considerable additional time was expended in contacting and following up with post secondary institutions and public utilities in an attempt to locate three field test sites for each of the seven courses. The final sites that participated and the number of students that participated for each course are presented in Table 2.

All field test sites with the exception of SCE&G are post-secondary two-year Associate Degree granting institutions. The nature of the students involved in the field test at each of these institutions was quite similar. In general, the students had technical interests but lacked real experience. Some had appropriate pre-engineering high school backgrounds, but many had the bare minimum in academic background to qualify for the nuclear technician program in which they were enrolled. The methods of instruction used at the post-secondary institutions varied from a standard lecture-discussion format with laboratory sessions (as appropriate) to self-paced independent study with no laboratory sessions at all. The backgrounds and training of the instructors also varied. However, all instructors involved were clearly qualified to teach the course(s) they were committed to teach. Student motivation was generated through the awarding of grades and through general interest.

Table 2

Field Test Sites

COURSE	SITE	STUDENTS ENROLLED*
1	Radiation Physics	
	a. Chattanooga State Technical College (CSTC)	14
	b. South Carolina Electric & Gas Co. (SCE&G)	13
	c. Texas State Technical Institute (Harlingen) (TSTI-H)	15
	TOTAL:	42
2	Radiation Protection 1	
	a. Chattanooga State Technical College	14
	b. South Carolina Electric & Gas Co.	9
	c. Texas State Technical Institute (Harlingen)	13
	TOTAL:	36
3	Principles of Process Instrumentation	
	a. South Carolina Electric & Gas Co.	9
	TOTAL:	9
11	Radiation Detection and Measurement	
	a. Chattanooga State Technical College	14
	b. Texas State Technical Institute (Harlingen)	14
	TOTAL:	28
14	Introduction to QA/QC	
	a. Texas State Technical Institute (Harlingen)	12
	TOTAL:	12
15	Metallurgy and Metals Properties	
	a. Tri-County Technical College (TCTC)	13
	b. Central Piedmont Community College (CPCC)	17
	TOTAL:	30
27	Metrology	
	a. Henry Ford Community College - Class 1 (HFCC-1)	11
	b. Henry Ford Community College - Class 2 (HFCC-2)	8
	TOTAL:	19

* Number of Students who completed at least one module posttest.

The one public utility site used in the field test was quite different from the post-secondary institutions. The trainees in the class were all employees of the utility and were working on the construction site of a nuclear power plant. Classes were scheduled when possible and attendance varied greatly depending on the demands of the trainees' regular work.

Most of the trainees had some technical school background and all had work experience but in most cases the prior experience did not include nuclear experience. The reward for participation in the classes was a "Certificate of Completion" issued by the instructor upon successful completion of the course. These certificates were of marginal value to the trainee for advancement. No laboratory sessions were used and very few demonstrations involving actual equipment were scheduled. Trainee participation varied according to the trainee's perception of the relevence of the topics being covered to his/her current job requirements

E. Instructor Orientation

Each instructor was provided with all the pertinent materials for the field test well in advance of actual implementation. GPC staff members provided technical assistance and general support for the instructors through telephone contacts and site visitations.

Site visitations by GPC staff were made to Chattanooga State Technical College, South Carolina Electric and Gas Co., and Tri-County Technical College. Each visitation team included the field test coordinator and a technical specialist. The purpose of the visits was to familiarize all parties involved with all aspects of the field test. Instructors at the other field test sites felt that visitations were unnecessary. Telephone contacts were used to facilitate field test implementations at all sites.

F. Data Collection

The data collected during the field test was of three types: achievement, evaluative, and descriptive. The achievement data was collected via pretests and posttests completed by the students (trainees). The evaluative data was collected as a means for judging the module content and to provide feedback useful for the revison of the modules. The evaluative data was collected using structured forms completed by the instructors.

Whereas the number of students and type of data collected allows for substantial statistical analysis of the achievement data providing some objective conclusions, the nature and quantity of the evaluative data allows only subjective analysis.

The descriptive data collected included the "Instructor Academic Background and Prior Experience Survey" forms and a verbal description of the general backgrounds of the students (trainees) in the course provided by the instructor (see previous section on Field Test Sites).

Achievement Data

Each course pretest was constructed as a set of subtests each of which consists of a subset of items from a module posttest. Each item on a pretest is identical to an item on a module posttest for the course. For each student (trainee) a set of item scores on the pretest was recorded and entered into the data base. Similarly, each module posttest yielded a set of item scores for each student (trainee) which was recorded and entered into the data base.

The scores on the pretest for items corresponding to items on the module posttests were summed to provide a set of module pre-scores for each student (trainee) (X_{i1}, X_{i2}, X_{i3}, ...X_{in} where n is the number of modules in the course).

Each module posttest provided two scores for each student (trainee), the first, T_{ij}, obtained by summing all item scores for the module j posttest and the second, Y_{ij}, obtained by summing the item scores on posttest j for those items appearing on the course pretest.

Evaluative Data

Each course yielded a set of "Instructor Module Evaluaton" forms (one per module), an "Instructor Course Evaluation", and a "Post Course Class Discussion of Curriculum Materials" form completed by the instructor. Since these forms all contained subjective evaluations and the number of instructors completing the forms for any one course was at most three, no attempt was made to quantify the data. A general discussion of the module revisions which were made based on the contents of these forms is provided in Section H of this report.

Descriptive Data

Each instructor completed the "Instructor Academic Background and Prior Experience Survey" form. This instrument provided general background information concerning the instructors. General information regarding the backgrounds and experience of the students in the classes was given orally to the GPC staff by the instructors during or immediately following the field test.

G. Data Analysis

Analysis of the achievement data collected from the students' pretests and posttests and the evaluative data collected from the instructors was used to provide a summative evaluation of the effectiveness of the modules. Two computable measures of effectiveness were examined: pretest-posttest gain and mastery of objectives.

Pretest-Posttest Gain

Pretest-posttest gain was assessed using a correlated-t statistic computed from the difference, $X_{ij} - Y_{ij}$, between matching subtests of the pretest and each module posttest. Each field test site was analyzed separately. Pooling of students from different sites for those courses tested at more than one site for the purposes of statistical analysis was rejected because of differences on pretests scores between sites, differences in the general characteristics of students (trainees) between sites, and differences in educational setting and/or instructors. Table 3 presents the descriptive statistics for the pretests.

Appendix D presents the data from the analysis of pretest-posttest gain. Column 10 indicates the significance of the gain. A single asterisk (*) is used to denote statistical significance at $\alpha = 0.05$ level, a double asterisk (**) for the $\alpha = .01$ level, and a check mark (✓) to denote a gain of at least one-half of the standard deviation of the X scores. This latter test was offered in the final revised field test plan as an alternative to a statistical test of pretest-posttest gain when the number of students (trainees) was too low to give reasonable statistical power for finding differences. The computation of the t statistic was accomplished through the use of the following formula:

$$t = \frac{\overline{Y} - \overline{X}}{\frac{\sqrt{S_x^2 + S_y^2 - 2r\, S_x S_y}}{\sqrt{N}}}$$

Where,

$\overline{Y}$ = mean of the sub-posttest

$\overline{X}$ = mean of the sub-pretest

S_x = standard deviation of sub-pretest scores

S_y = standard deviation of sub-posttest scores

r = correlation coefficient for the correlation between the sub-pre-test and sub-posttest scores

N = number of students (trainees) taking both tests

The t statistic used is commonly refined to as a "correlated-t" since the standard error of the difference (the denominator) is a function of the correlation of the two sets of scores.

Table 3

Descriptive Statistics for Course Pretests

COURSE	SITE*	N	MEAN	STANDARD DEVIATION
1	CSTC	14	31.3	7.7
	SCE&G	13	41.2	6.9
	TSTI-H	15	27.1	8.9
2	CSTC	14	5.0	2.9
	SCE&G	13	8.1	5.2
	TSTI-H	12	6.3	3.0
3	SCE&G	12	14.9	13.2
11	CSTC	14	17.4	9.3
	TSTI-H	13	5.9	3.8
14	TSTI-H	12	NOT GIVEN	---
15	TCTC	12	3.6	2.6
	CPCC	17	1.0	1.1
27	HFCC-1	12	10.1	6.1
	HFCC-2	9	10.4	4.2

*CSTC = Chattanooga State Technical College
SCE&G = South Carolina Electric & Gas Co.
TSTI-H = Texas State Technical Institute - Harlingen
TCTC = Tri-County Technical College
CPCC = Central Piedmont Community College
HFCC-1 = Henry Ford Community College - Class 1
HFCC-2 = Henry Ford Community College - Class 2

Examination of Appendix D indicates that all modules for courses 1, 2, and 11 produced statistically significant gains at all field test sites.

Course 3 produced statistically significant gains for five out of the six modules tested with module 6 being the only exception. However, since the number of trainees who took both the pretest and the module 6 posttest is only nine, the power of the statistical test is limited. Therefore, use of the alternative test described in the final revised field test plan is appropriate. Comparing the gain of 0.9 to the standard deviation of the sub-pretest score (1.8) shows a gain of half of the sub-pretest standard deviation. We, therefore judge this gain to be acceptable.

Unfortunately, no pretest was given at the one site which field tested Course 14. This was not known by GPC until after the course was completed. The instructor claimed that the petest would have been too hard for the students and decided not to give it. This precludes any evaluation of pretest - posttest gain for Course 14.

Course 15 shows statistically significant gains for all modules at both sites with one exception: module 4 at TCTC. The gain for module 4 at TCTC was 0.4 relative to a standard deviation of 1.2 for the sub-pretest, so the secondary test for acceptable gain also fails. However, because of the way this course was taught (individually paced self-study with no laboratory work), GPC does not feel that this result indicates any particular weakness in this module, especially since module 4 showed an extremely significant gain at the other site (CPCC).

Course 27 also produced statistically signifient gains for most of the modules in both classes at HFCC. The first class failed to produce statistically significant gain for module 1, but the secondary test (Gain of 3.5, more than half of standard deviation of sub-pretest (2.0)) shows as acceptable gain. Module 6 shows a statistically significant gain for the first class with no test possible for the second class because only one student took the module 6 posttest. Module 7 shows no significant gain by either class. This module is therefore a candidate for revision and are discussed in greater detail in Section H of this report.

In summary, the analysis of pretest-posttest gain showed acceptable gains for all but 4 modules. These 4 modules are discussed in Section H of this report.

Mastery

The degree of mastery of the objectives tested for a student (trainee) is directly measured by the student's (trainee's) total posttest score. The extent of mastery of a given objective is directly measured by the percent of students (trainees) correctly responding to the test item(s) used for that objective. Both of these measures are related to the effectiveness of the module in meeting the stated objectives and consequently is of interest to the curriculum revision team.

Table 4 presents the mean percent correct for each module broken down by course and field test site.

Interpretation of results displayed in Table 4 is extremely difficult. Some of the factors contributing to this difficulty are the lack of normative data for the populations involved, lack of student background data, differences between field test sites, and the lack of an acceptable standard of performance. The first three factors are beyond the control of this field test and therefore must be ignored. The fourth factor, lack of an acceptable standard, can be solved by the ad hoc adoption of some arbitrary standard of performance for each module. Since 60% would normally be a "passing" score or acceptable level of achievement at a post-secondary institution, 60% was used as the arbitrary benchmark relative to which the results in Table 4 was judged.

Inspection of Table 4 indicates that the results obtained for courses 1 and 2 t all sites are acceptable. Course 3 produced unacceptable results for Modules 1 and 4 at SCE&G. Course 11 produced low posttest mean only for Module 1 at TSTI. Course 14 produced acceptable averages for all Module posttests. Course 15 shows problems with Modules 3, 4, 7, and 8 at TCTC and Modules 1, 2, 3, 7 and 8 at CPCC. These problems are discussed further in section H of this report.

Table 4

Class Mean % Correct

COURSE	SITE	MODULE 1	2	3	4	5	6	7	8	9
1	CSTC	89	83	84	71	92	75	NA	NA	NA
	SCE&G	89	82	80	63	80	65	NA	NA	NA
	TSTI-H	89	82	89	85	89	78	NA	NA	NA
2	CSTC	67	75	73	79	90	69	NA	NA	NA
	SCE&G	71	72	66	68	83	76	NA	NA	NA
	TSTI-H	80	86	76	79	90	83	NA	NA	NA
3	SCE&G	49	66	65	49	72	63	*	*	NA
	---	-	-	-	-	-	-	-	-	-
	---	-	-	-	-	-	-	-	-	-
11	CSTC	75	84	88	83	63	78	80	80	NA
	TSTI-H	53	77	*	*	*	*	*	*	NA
	---	-	-	-	-	-	-	-	-	-
14	TSTI-H	68	91	88	88	66	79	*	86	81
	---	-	-	-	-	-	-	-	-	-
15	TCTC	65	73	47	27	62	66	59	40	NA
	CPCC	49	50	51	66	75	65	56	53	NA
	---	-	-	-	-	-	-	-	-	-
27	HFCC-1	44	63	53	49	67	66	12	15	NA
	HFCC-2	82	86	63	72	76	3	43	43	NA
	---	-	-	-	-	-	-	-	-	-

* Posttest Not Given
NA = Not Applicable

Course 27 also showed potential problems with Modules 1, 3, 4, 7, and 8 with HGCC-1 and Modules 6, 7, and 8 with HFCC-2.

More detailed analysis of individual posttest items is provided in Appendix E which provides the mean percent correct for each item broken down by module, site, and course. The table in Appendix E provides information of interest for all modules including those judged acceptable by previous measures. This data provides potential for improvement of all modules by indicating which items caused the most difficulty for the students (trainees).

Again, an arbitrary standard of 60% can be applied to the results displayed in Appendix E. Using that standard, the items displayed in Table 5 are the items that appear to cause difficulty for the students (trainees) at all field test sites used. If at least one field test site produced an acceptable result for a particular item it is reasonable to attribute the apparent difficulties with that item at other site(s) as being due to site differences (i.e, instructor emphasis, omission of the material from the course, availability of necessary equipment, etc.).

The findings displayed in Tables 4 and 5 are not independent. Since the total posttest score is defined as the sum of the item scores, any module with an unacceptable average total score must have some unacceptable item scores. However, the converse is not true. An acceptable average total score does not imply that all items will have acceptable average scores. The implications for module revision are not clear. The last source of data on module effectiveness, the subjective evaluative data supplied by the instructors via the "Instructor Module Evaluations", "Instructor Course Evaluation", and the "Post Course Class Discussion of Curriculum Materials" needs to be examined for further clues.

Other Measures of Module Effectiveness

It was originally planned to have subjective evaluative data of module effectiveness from both students (trainees) and instructors (see Appendix A). However, all student (trainee) supplied evaluations were eliminated from the

Table 5

Posttest Items With Less Than 60% Successful Completion At All Sites

COURSE	MODULE	ITEMS
1	1	None
	2	None
	3	None
	4	None
	5	None
	6	11, 12, 13
2	1	2, 3, 9, 11
	2	8
	3	5a-2, 5b-2, 5c-1, 5c-2, 5d-2
	4	None
	5	None
	6	None
3	1	1, 3, 5, 6, 17
	2	5a, 5b, 5c, 6b, 6c, 7a, 7b, 12
	3	9e, 16, 22a, 24
	4	1, 2, 3, 5, 6, 7d, 7e, 8, 9, 11, 12, 13, 14, 17
	5	8, 10a, 11, 13, 14, 20
	6	4, 5, 8, 11a, 11b
	7	---
	8	---
11	1	14, 15, 17, 18, 19
	2	13, 14
	3	8, 14, 15
	4	5, 7a,b,c, 16
	5	3c, 4c, 12, 15, 16a,b,c,d, 17, 18, 19
	6	1f, 9, 11, 12, 19c
	7	5, 9, 11a,c, 12
	8	6b, 12

COURSE	MODULE	ITEMS
14	1	6, 7, 8, 9, 10, 11, 13, 14, 15
	2	5a
	3	3, 4
	4	None
	5	None
	6	None
	7	No posttest given
	8	None
	9	None
15	1	4d, 4f, 6, 7, 11, 12, 13, 14, 15
	2	5, 8, 9
	3	2, 7, 8a, 8c, 8d, 9b, 9c, 10, 11b, 11f
	4	2, 3, 7b, 9, 13
	5	7
	6	7a, 9, 12, 19
	7	2, 3, 4, 6, 8b, 8d, 8f
	8	3, 4, 5, 6, 7, 9, 11, 13
27	1	20
	2	5, 11c
	3	3, 5, 9a, 9b, 14, 15a, 15b, 16, 17, 18a-d
	4	1, 3a, 3b, 4, 6, 8, 9, 10, 13, 14, 15
	5	16a, 16b, 17, 18, 19, 20, 21
	6	2, 3a, 3b, 4, 5a-d, 19, 20
	7	2a-c, 3, 4a-c, 5, 6a-c, 7a-c, 8, 9
	8	3, 4, 5, 6, 7, 9, 10, 12

field test plan at the request of the government project officer. The remaining data to be considered for evaluating module effectiveness and ultimately directing any module revision efforts is the data supplied by the instructors. Appendix B contains samples of the three forms used for collecting this data.

The evaluative data is very course specific and will therefore be discussed in the context of implied revisions in the next section of this report.

H. Module Revision

Materials for courses 1, 2, 3, 11, 14, 15 and 27 were revised based on the field test results. Each module was evaluated using (1) the analyzed pretest-posttest gain; (2) the degree of mastery achieved; (3) examination of each posttest question with less than 60% successful completion at all sites (Table 5); (4) individual instructor comments on the "Instructor Module Evaluation" and "Instructor Course Evaluation" forms; and (5) the "Post Course Class Discussion of Curriculum Materials" feedback. Based on this information, GPC identified those modules requiring revision. Table 6 lists the revisions (other than correction of typographical or grammatical errors) which were made to these course materials. The following paragraphs describe the actions taken for all modules which were candidates for revision based on analyzed field test data.

For Course 1, pretest-posttest gain was satisfactory for all modules as was the degree of mastery. Only three posttest items in Module 6 had less than 60% successful completion at all sites (see Table 5). Upon examination of Module 6, it was found that these questions all required calculations and that the students (trainees) either used incorrect mathematical relationships or performed calculations incorrectly. It was found that the module subject matter adequately explains and demonstrates the use of the formulas in question. Because of this and the fact that the instructors found the module satisfactory, no revisions were made.

Table 6

Module Revision Summary

COURSE	MODULE(S)	PAGE(S)	REASON(S) FOR REVISION*
1	1-6	None	
2	1-6	None	
3	1	None	
	2	6-8	A,B
	3-8	None	
11	1	None	
	2	30	B
	3	None	
	4	14, 18	B
	5-8	None	
14	1-9	None	
15	1	4, 6, 7, 8, 9, 19	A,B
	2	3, 8, 9	A,B
	3	3, 5, 6, 13	B
	4	5, 7, 8	B
	5	None	
	6	1, 7, 10, 13, 17, 18, 19, 28	A,B
	7	1, 2, 4, 5, 6, 7, 16	A,B
	8	2, 4, 5, 6, 7, 8, 9, 10, 11, 23	A,B
27	1	4, 6, 8, 11, 12, 16, 17, 25, 26, 28	A,B
	2	5-8, 16, 23, 31, 32	A,B
	3	20, 33	A,B
	4	1	A,B
	5	10, 12	A,B
	6	42	A,B
	7	4, 7, 14-16, 32, 36	A,B
	8	1, 4, 6, 20	A,B

* A = Specific posttest questions exhibited less than 60%.
B = Instructor evaluation of module indicated areas needing clarification or amplification.

For Course 2, pretest-posttest gain and degree of mastery were satisfactory. Table 5 identifies several test items in Modules 1, 2 and 3 which warranted examination. Upon examination of these questions and the graded posttests, it was determined that all of these test items involved the definitions of radiation protection terms which were adequately explained in the module subject matter. Posttest answers appeared to be incomplete, rather than completely wrong. This was the students' (trainees) first exposure to these terms and it was determined that no module revision was necessary due to less than 60% successful completion at all sites.

For Course 3, pretest-posttest gain was satisfactory, but the degree of mastery of Modules 1 and 4 was not. Table 5 lists questions from Modules 1 through 6 which had less than 60% successful completion. After reviewing the modules and posttests as well as the instructor comments, it was determined that the lack of mastery was not due to the curriculum materials. The problems apparently resulted from insufficient time being allowed for classroom presentations and the fact that very few of the laboratory exercises were carried out during the course. The subject matter coverage in all modules was deemed to be satisfactory. As shown in Table 6, several pages in Module 2 were revised, however, for the correction of errors noted by the instructor.

For Course 11, pretest-posttest gain was satisfactory for all modules, as was the degree of mastery. As a result, there were no revisions made to the modules on these criteria. Modules 2 and 4 required some minor technical corrections based on the instructor's evaluations of the material. In general, the instructors were satisfied with Course 11.

For Course 14, no pretest was given because the instructor apparently misunderstood the field test instructions. He felt that the pretest was too difficult for his students and they would have probably scored a "zero" on the test had it been administered. The posttest results for Course 14 were very satisfactory for all modules tested. Since the instructor's comments about the modules was also favorable there were no revisions made to these modules.

For Course 15, pretest-posttest gain was marginal for several modules as was the degree of mastery. This along with numerous instructor comments about areas needing clarification or amplification resulted in technical revision of all modules except module 5 which was identified as being satisfactory.

For Course 27, only module 7 did not have acceptable pretest-posttest gain. However, the degree of mastery was inadequate at one or both sites for Modules 1, 3, 4, 6, 7 and 8 with Modules 7 and 8 mastery inadequate at both sites. Table 5 lists some test items with less than 60% successful completion in all modules. Review of each module, each posttest and instructor comments revealed areas for possible improvement in all modules. As indicated in Table 6, each module was revised. In some cases only a few pages were changed, while in one case (Module 7), substantial rewriting was necessary. In all cases, text and graphic materials were added to the subject matter as were clarified and additional exercises and procedures were included to further reinforce the material.

III. DEVELOPMENT OF TEACHING/LEARNING MODULES

A. Technical Specialty Courses

Seven technical specialty courses were developed for use in the second year of the Nuclear QA/QC Technician Curriculum. These seven courses are listed in Table 7.

Table 7 Second Year QA/QC Technical Courses

COURSE NUMBER	COURSE TITLE
26	Nondestructive Examination (NDE) Techniques I
27	Metrology
28	Welding Inspection
29	Civil/Structural Inspection
30	Mechanical Inspection
31	Quality Assurance Practices
32	Nondestructive Examination (NDE) Techniques II

Each of the seven technical courses is comprised of from six to ten modules. Each module of a course provides unitized instruction on major course topics. Module titles and objectives for each of the seven technical courses are listed in Appendix F.

B. Advisory Committee

An Advisory Committee was used extensively during the project. The key functions of this committee were (1) to assure that job-oriented course materials were developed and (2) to provide professional review of the Nuclear QA/QC Course modules. Early in the project, the Advisory Committee performed a detailed task analysis for the Nucelar QA/QC Technician. This task analysis was used by the project staff to prepare objectives for each module which accurately reflected the job tasks of Nuclear QA/QC Technicians.

As course modules were developed, copies were forwarded to the Advisory Committee for review. Subsequently, modules were revised to resolve review comments received.

The Advisory Committee was established at the onset of the project and it included recognized authorities in the nuclear field. The committee membership included representatives from both academia and industry. Members of the Advisory Committee are listed in Appendix G.

C. Approach to Course Development

At the beginning of this phase of the project, a course development procedure was established to assure that the final modules accomplished the established objectives. This program included task analysis, draft module development, independent review, and module revision.

Task Analysis

Early in the project, the Advisory Committee held a two-day meeting with the key project team members. During this meeting, a detailed job analysis was performed to identify the tasks performed by Nuclear QA/QC Technicians.

The task analysis disclosed that the Nuclear QA/QC Technician performs functions in the electrical, mechanical, and civil engineering fields. Within these fields, the technician may serve in a variety of specific assignments, including inspector, surveillance technician, assistant to QA engineers, laboratory technician, technical writer, and auditor. It was concluded that the best career pattern description of the technician is "QA/QC Engineer in Training". This description is based on a career pattern which leads to either engineering or inspection supervisory positions.

The detailed task list was compared with the course descriptions provided by DHEW. This comparison identified the potential need for additional courses in the Nuclear QA/QC Technician curriculum. The detailed task list was then compared with draft module objectives which had previously been prepared by the project team. This comparison identified the need for some revisions and additions to the draft module objectives. Subsequent to the meeting, the project team finalized objectives for each module using the results of the Advisory Committee meeting. These final module objectives were used throughout the remainder of the project to assure that the modules included task-oriented instructional materials.

Module Development and Review

A total of 53 modules were developed for the seven specialty courses. These modules were developed under the direction of the Project Manager and Course Development Coordinator by a team of technical writers and curriculum specialists. Two Associate Professors with curriculum development experience were employed as project consultants. These consultants significantly contributed to module development by providing (1) training of technical writers, (2) independent review of draft modules, and (3) general consulting services throughout the project. Technical writers were selected based on their subject matter expertise and experience in training programs. The overall module development process is illustrated in Figure 1.

Technical writers prepared handwritten drafts of modules using course and module objectives, resource materials, and personal experience. Resource materials included rules, regulations, codes, standards, reference books, equipment suppliers' literature, technical publications, and user experience reports. A key ingredient was the GPC project staff's ability to discuss present-day job environments with clients having projects involving the topics covered by the modules. This dialogue permitted reinforcement and amplication of technical writers' knowledge and conceptions of specific on-the-job applications of the technologies being addressed.

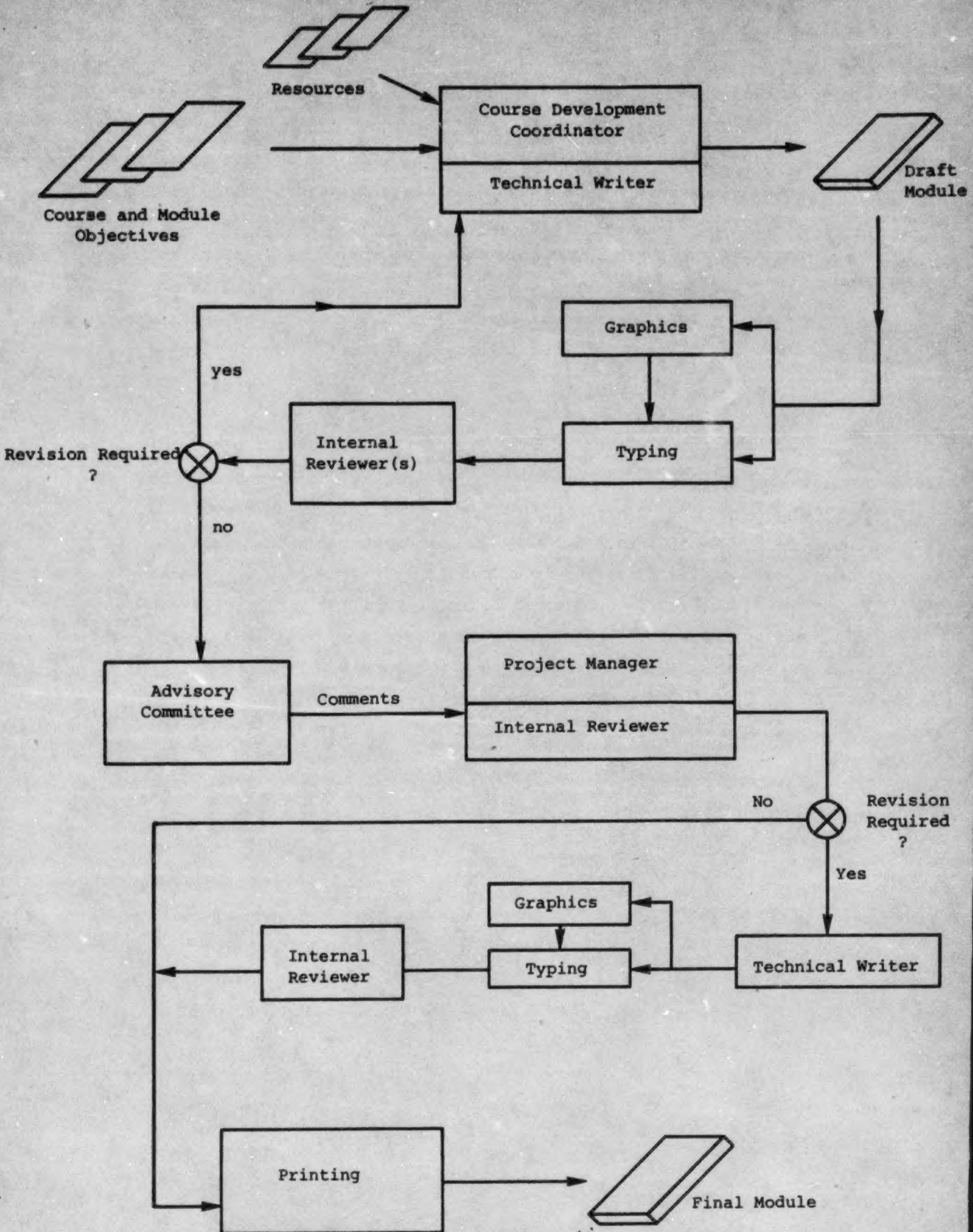

Resources
Course Development Coordinator
Technical Writer
Course and Module Objectives
Draft Module
Graphics
yes
Internal Reviewer(s)
Typing
Revision Required ?
no
Advisory Committee
Comments
Project Manager
Internal Reviewer
No
Revision Required ?
Yes
Graphics
Internal Reviewer
Typing
Technical Writer
Printing
Final Module

Figure 1 Module Development Process

Internal reviews were applied at two key points: (1) prior to sending modules to the Advisory Committee and (2) during incorporation of comments received from the Advisory Committee. Internal reviews were performed under the direction of the Project Manager and by persons other than the technical writer of the module being reviewed.

Advisory Committee comments were rarely extensive but led to definite improvements. Most comments identified the need for further amplification of specific concepts or for simplification of their presentation. The review confirmed the coverage of course and module objectives.

A strong administrative system was necessary to track the status of the 53 modules. The number of modules, number of reviews, and potential for revisions gave a degree of complexity which had to be handled administratively. Accordingly, an administrative coordinator was assigned to track module status and to help ensure that all specified reviews were accomplished. All graphics work was performed by General Physics Graphics Department. Printing of modules was accomplished by General Physics Reproduction Department using offset printing techniques.

D. Recommendations for Additional Courses

Nondestructive Examination

During the task analysis performed by the Advisory Committee, 18 test methods were identified which were deemed important to functions of the Nuclear QA/QC Technician. In addition, the Advisory Committee recommended that the course materials describe the role of the Authorized Inspector and the American Nuclear Insurers (formerly NEL-PIA) representative. The DHEW contract to develop Nucelar QA/QC Technician Course Modules required only eight of the nondestructive test methods to be covered and did not require coverage of the remaining ten test methods. In addition, neither the role of the Authorized Inspector nor the American Nuclear Insurers' representative was required by the DHEW contract. A listing of these test methods is given in Appendix H.

Of the ten test methods not required by the DHEW contract, two test methods are frequently employed by nuclear activities. These are electrical testing and calibraiton of instrumentation and control systems. An entire course is considered necessary to adequately cover each of these two areas. Presently, the DHEW listing of specialty courses for nuclear technology curricula does not include an electrical testing course but lists two courses that may cover calibration of instrumentation and control systems. These two courses are: - Course 6, Instrumentation and Control of Reactors and Plant Systems and Course 34, Advanced Nuclear Instrumentation.

The remaining eight test methods not required by the DHEW contract can be grouped by usage factor as follows:

- One test method is unique to fuel processing. This method is neutron radiography which applies more to the Nuclear Materials Processing Technology than the Nuclear QA/QC Technology. Therefore, it is recommended that this test method be added to the Nuclear Materials Processing Technology curriculum.
- Two test methods are in stages of development. These are Acoustic Emission and Vibration Analysis. General Physics considers that widespread use of these tests will occur in the foreseeable future. Accordingly, it is recommended that courses be developed on these two test methods.
- Five test methods are employed throughout the nuclear industry, although the frequency of use varies considerably from site to site. These five are Beta Testing, Inservice Inspection of Concrete, Holography, Microwave Testing and Sodium Testing. It is recommended that courses be developed on these test methods.

Electrical Inspection

As previously mentioned, electrical testing and calibration are not presently identified as part of the Nuclear Technology Series. Because this is an important function, the Advisory Committee strongly suggested that a Course 35 be added to the existing Nuclear Technology Series. This course should be entitled "Electrical Inspection" and should contain the topics listed in Appendix I.

IV. PROMOTION OF NUCLEAR TECHNOLOGY CURRICULA

The third objective of the project was to familiarize educational institution, industry and related personnel with the Nuclear Quality Assurance/Quality Control and the Nuclear Reactor Operator (Trainee) Curricula.

On July 1, 1978, General Physics mailed approximately 1400 brochures to:

- Curriculum Coordination Centers
- State Directors of Vocational Education
- Deans of Occupational Education Programs
- Plant Superintendents at Nuclear Power Stations
- QA/QC Managers at Nuclear Power Stations
- Members of the American Society for Quality Control (ASQC)

Favorable interest in this program was shown by responses received by both General Physics and the U.S. Office of Education.

Appendix J gives a sample of the Nuclear Technology Brochure and the cover letter disseminated during this promotional activity.

APPENDIX A

REVISED FIELD TEST PLAN

REVISED FIELD TEST PLAN

A. OVERVIEW

The following field test plan is designed to be implemented on a course by course basis (i.e., the unit of implementation is a course). This allows maximum flexibility for field testing the seven (7) courses of the Nuclear QA/QC Curriculum within the constraints imposed by the field test sites.

The overall goal of the field test is to field test each course at three (3) different sites. Testing all seven (7) courses at each of three (3) sites is the preferred model and will be implemented where possible. However, academic year calendars and the special needs and constraints of the participating field test sites make it necessary to design a plan that can be implemented on a course by course basis.

Specific field test site commitments and implementation plans are presented in Appendix B. The field test will be conducted to provide information to determine the effectiveness of the course materials as tested (summative evaluation) and to provide specific feedback to the curriculum development team to aid in the revision of the seven (7) tested courses and the initial development of the six (6) additional courses in the Nuclear QA/QC Curriculum (formative evaluation).

The following questions are addressed by this field test:

1. Are the course materials infusible into technical education programs?

2. Are the course materials usable by students (trainees) and instructors in their present form?

3. Are the objectives of the courses' modules achieved by the students?

4. Are the course materials interesting to the students (trainees) and instructors?

Question 1 addresses the relevance of the curriculum itself, question 2 concerns the usability of the materials in their present form, and questions 3 and 4 concern the effectiveness of the materials in terms of achievement and interest.

The existence of the Nuclear QA/QC Curriculum materials to be tested is a direct result of prior efforts to identify specific needs for nuclear technicians, develop a model curriculum (including course descriptions and module listings), and produce specific content modules for some of the courses. However, the relevance of the course materials as they now exist needs to be confirmed by use in an instructional setting. Data will be gathered from the instructors and administrators involved in the field test, via questionnaires and informal de-briefings at the conclusion of their participation in the field test, to confirm the relevance of the course materials.

The usability of the course materials in an actual classroom setting has not, as yet, been documented. To be usable, the course materials must be appropriate to the reading level of the intended audiences, logically sequenced, and technically accurate. In additon, the format must be adaptable to the instructors' teaching styles. Information concerning these dimensions of usability will be gathered through the use of module evaluation forms completed by the instructors at the conclusion of each module and course evaluation forms (one for students (trainees) and one for instructors) completed at the end of the course. Informal de-briefings of the instructors will also be used to provide insight into specifics not covered by the evaluation forms and to follow-up items on the evaluation forms that need amplification.

Annotated records and specific module page and line-referenced comments will be obtained through the use of a special tear-out section for each page of each module provided for instructor and student use. It is anticipated that this provision will generate useful formative data on the usability and relevance dimensions as well as on other dimensions of the field test.

The effectiveness of the course materials will be measured through the use of objective referenced pretests and posttests. Two specific analyses will be conducted. One will focus on evidence of student achievement gain between pretest and posttest. The other will deal with evidence of post course student mastery of the course objectives. The specifics of the data analyses are provided later in this document.

B. GENERALIZED IMPLEMENTATION PLAN

The expected field test sites fall into two categories: community college/technical schools and on-site public utility training facilities. The basic organization, needs, time constraints, and other factors involved are sufficiently different between the two categories, as well as within the categories, to necessitate a generalized field test implementation plan that can be modified to suit the special needs of a given site.

One model for a field test is a program-oriented model. A program-oriented field test would provide, at each site, a test of all seven (7) specialized technical courses of the Nuclear QA/QC technician curriculum taught in the recommended sequence concurrently with other courses in the recommended program (see Attachment E to RFP 77-36).

A more flexible approach is a course-oriented field test model which views the Nuclear QA/QC technician programs as a collection of courses that can be taught independently, providing the necessary course prerequisites are satisfied. For example, if a post secondary school or utility wants to use the modules of a course and is satisfied that the prospective students (trainees) have background knowledge and experience equivalent to the stated prerequisites of the course, a course-oriented field test plan allows for that site's participation in the field test. A field test plan that does not provide for such flexibility severely limits the list of potential field test sites; whereas, the usability of the curriculum stands to be increased by a flexible field test plan. Also, a course-oriented model offers the advantage of allowing the program-oriented field test as a special implementation.

The plan that follows is course-oriented to provide needed flexibility. However, General Physics intends to implement the plan in a program-oriented manner if an appropriate field test site can be secured.

The field test will progress through the following stages:

- site selection
- development of implementation schedule
- orientation of instructors
- implementation and data collection
- data analysis
- final report

Site selection includes identification, initial informal contact, formal communication, negotiation, and confirmation. Potential field test sites were identified through several sources: professional contacts of General Physics personnel, a list of community colleges and technical schools offering nuclear programs (list supplied by Mr. William Berndt, BOAE, USOE, DHEW), and direct contact of General Physics by schools interested in participation. At present, General Physics is negotiating with ten (10) potential field test sites. Any confirmed sites and the extent of their commitment at the time this plan is submitted are detailed in Appendix B.

The development of the implementation schedule for each site will be a joint effort by the field test team at General Physics and the appropriate administrators and instructors at the field test site. Specific site visits by members of the field test team, instructor preparation, course start dates, pretest dates, posttest schedule and other pertinent data collection activities will be scheduled. It is anticipated that the implementation schedules will vary from one field test site to another.

The orientation of instructors will familiarize the instructors with specific course materials, provide answers to technical questions by a General Physics technical consultant, assist instructors in gathering and preparing special materials, and inform the instructors of the specific data collection requirements of the field test plan. It is expected that a member of the field test team and/or a technical consultant will visit the field test site during this period. Instructor background information will be obtained during the on-site visit.

The implementation and data collection phase of the field test will begin with the first class meeting of students with the instructor. This phase covers the actual teaching of the course and includes the collecton of student (trainee) background, pretest, posttest, and module and course evaluation data. The implementation phase ends with the completion and return of all data collection instruments to General Physics.

Data analysis will be conducted by the field test team at General Physics. . Details are provided in section D of this document.

The final report will be written upon completion of data analysis for the last field test site completing and returning required data. This report will be submitted to the Bureau of Occupational and Adult Education, USOE, DHEW at the conclusion of the contract period.

C. DATA COLLECTION

To obtain a description of the field test subjects, as well as quantifiable data to address the relevance, usability and effectiveness of the field tested courses of the Nuclear QA/QC curriculum, several types of data will be used and various techniques of data collection will be employed. Structured response forms will be used to collect data on student (trainee) and instructor academic background and experience, student (trainee) and instructor evaluations of each course, and instructor evaluations of each module. Objective-type pretests and posttests that parallel the learning objectives of the modules/courses will be used to collect student (trainee) achievement data. An open-ended data collection technique designed to elicit student (trainee) and instructor reactions to specific module content will be provided in the form of a special tear-out section adjoined to each page of each module.

Sample description is a necessary part of all field tests. The generalization of the conclusions based on the field test results is limited to the representativeness of the sample. For this reason, data concerning the curriculum's usability must be collected and presented in the final field test report. Data concerning the academic background and experiences of both the instructors and students involved in the field test are considered essential demographics for interpretation of data analysis and generalization. The two instruments to be used for sample description, the Student (Trainee) Academic Background and Experiences Survey and the Instructor Academic Background and Experiences Survey, are included in Appendix C of this document.

The relevance of the curriculum as well as its usability are, in part, functions of individual perceptions. The instructors and students (trainees) must perceive the content to be relevant to career goals. Also, for the materials to be usable, the instructors and students (trainees) must find the format of the course materials to be adaptable to their teaching or learning styles. The purpose of collecting data on usability and relevance is two-fold: to directly obtain summative data for the curriculum as field tested and to indirectly gather formative data for revision of the field test courses. The dimensions of usability and relevance addressed include the clarity of presentaiton, difficulty of concepts, logical flow of subject matter, format of materials, and appropriateness of exercises and procedures. The structured instruments to collect this data - the Student (Trainee) Course Evaluation Form, the Instructor Module Evalaution Form, and the Instructor Course Evaluation Form, are given in Appendix C.

In addition to the structured questionnaires, a special open-ended data collection technique will be used to collect both summative and formative data from the students (trainees) and instructors. The course materials will be duplicsted from 8 1/2" x 11" masters on 11" x 14" paper. This will allow an extra 5 1/2" to one side of the text material. The outermost 3" will be ruled off by a performation line. Page numbers will be copied on the outer 3". Students (trainees) and instructors will be encouraged to write specific comments concerning the text material on the 3" tear-off section of each page. Comments will be solicited regarding sentence/paragraph/figure clarity and other dimensions of the course materials. If a particular page, paragraph, figure or sentence needs revision due to lack of clarity, difficulty of technical content, or other reason, it is expected that indications will be present with sufficient frequency to validate the need for revision. It is hoped that very specific formative feedback will be obtained in this manner. A scoring procedure will be developed for judging student and instructor feedback from these tear-off sheets and these scores used as part of summative evaluation of the course material usability. The instructions to the students (trainees) and instructors for use of the tear-outs are given in Appendix C.

Measures of the effectiveness of the course materials will be obtained through the use of pretests and posttests designed to parallel the learning objectives of the courses. Each module currently contains a posttest written by the original author(s) of the module. Many of the questions written by the original author(s) are not in an objective format. As many of these questions as possible will be modified to an objective format. These modifications are necessary to maximize the reliability of pretest and posttest scores and to reduce the amount of testing time reqired. Questions from the original module posttest will be included in the modified posttest if they meet the following criteria:

- The question pertains to a stated module objective and can be modified to an objective format or the question is already in an objective format.
- The answer to the question can be found in the textual material of the module being tested.

No judgement of the infusibility, relevance, or usability of either the objectives or test questions written by the original author(s) will be made.

Answer keys with scoring instructions will be constructed for each module posttest and supplied to the instructors.

Any question that is part of the original module test but cannot be modified to an objective format without losing the intent of the question will be supplied to the instructors. Provision for using questions other than those on the field test posttest is made because General Physics does not wish to constrain the instructor to use only the objective type posttest for evaluation of student progress.

For each course, a single representative pretest will be constructed by a stratified random selection of items from the collected module posttests for the course. The stratification will insure that some objectives from each of the modules will be pretested allowing the use of pretest data in an analysis of pretest-posttest gain as a measure of module as well as total course effectiveness. The pretest will be prepared so that they may be administered in one class period or 45 minutes.

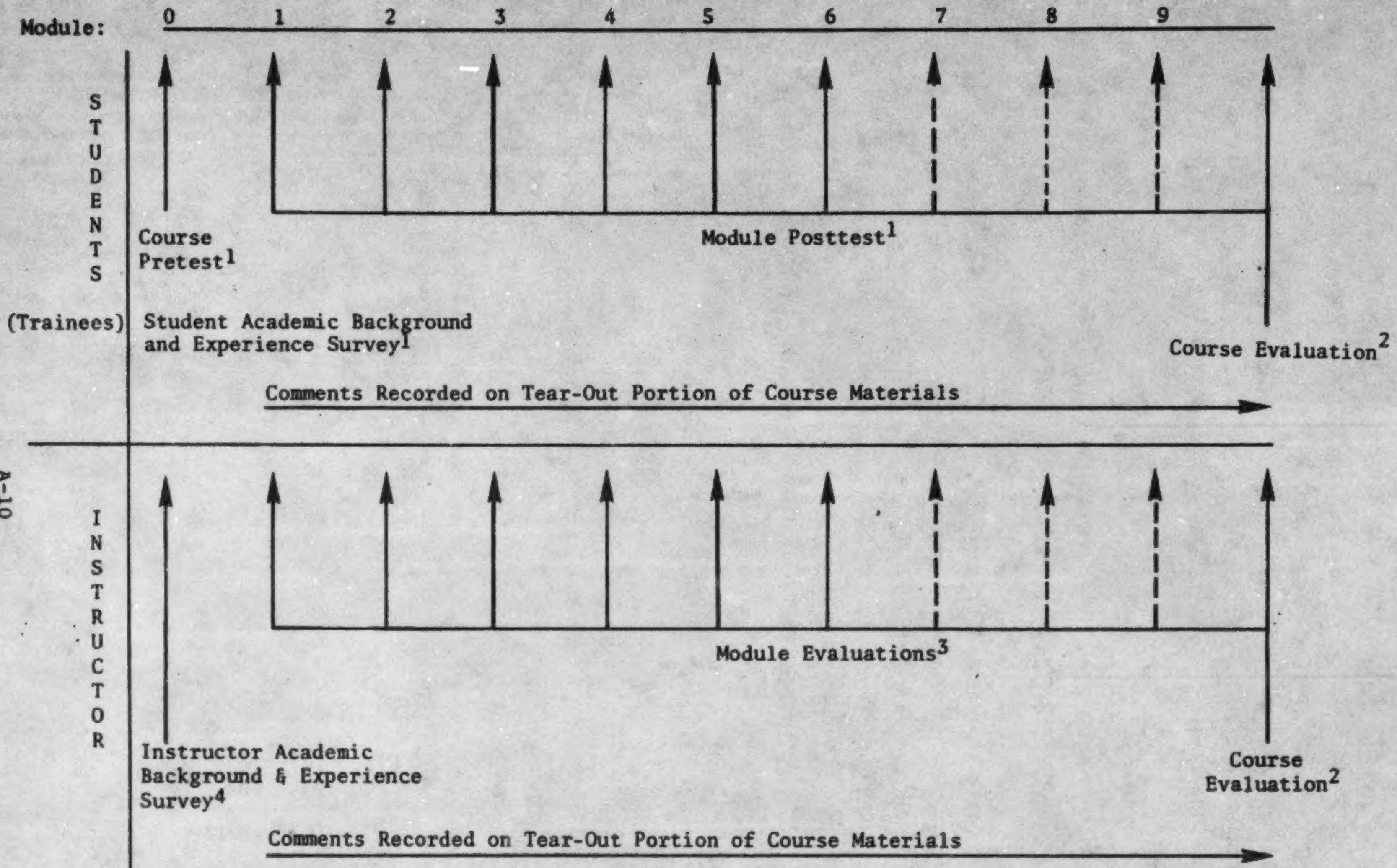
Sample module posttests with answer keys, a course pretest with answer key and instructions for use are given in Appendix C.

A schematic representation of the collection of the necessary data is given in the following diagram. This digram represents the data collection at a post secondary school implementation of the field test plan. The actual administration of posttests will vary according to the completion time of each module and the number of modules. Also, the length of the course will expand or shorten the time schedule as appropriate.

D. DATA ANALYSIS TECHNIQUES

For summative evaluation of the effectiveness of the presentation of the objectives tested on the posttest of a module, the following scores will be used:

- A pretest score (X_{pre}) based on item scores from the course pretest items that match items on the module posttest.
- A posttest score (X_{post}) based on item scores from the module posttest for those items that match coure pretest items.
- Posttest item scores.
- A posttest score (T_{post}) based on all item scores from the posttest.


Module:
0
1
2
3
4
5
6
7
8
9
STUDENTS
(Trainees)
Course Pretest[1]
Module Posttest[1]
Student Academic Background and Experience Survey[1]
Course Evaluation[2]
Comments Recorded on Tear-Out Portion of Course Materials
INSTRUCTOR
Module Evaluations[3]
Instructor Academic Background & Experience Survey[4]
Course Evaluation[2]
Comments Recorded on Tear-Out Portion of Course Materials

1. Returned to General Physics as soon as completed in the pre-paid envelope provided.
2. Completed after the last posttest and returned to General Physics with the last posttest.
3. Completed at conclusion of each module and returned with module posttests.
4. Return with pretests.

GENERALIZED DATA COLLECTION SCHEDULE
COURSE FIELD TEST

The scores from the matching pretest and posttest items (X_{pre} and X_{post}) will be analyzed to assess module pretest-posttest gain. The posttest item scores and the total posttest score (T_{post}) will be used to assess student mastery of the objectives tested on the module posttest.

1. Pretest-Posttest Gain

The pretest-posttest gain for a module will be analyzed using a correlated-t statistic. The samples of students (trainees) from all field test sites using the module will be pooled, provided that the pretest means for the samples are not significantly different. If any pretest mean scores for a sample are significantly different from the other samples, a separate test will be made for the different sample. The use of pooled scores maximizes the power of the statistical test. With pooled scores for 30 subjects (3 field test sites x 10 subjects per site), the probability of achieving a statistically significant ($\alpha = .05$) gain from pretest to posttest (i.e., the power of the statistical test) is 86% when the true population gain is 1.5 points and the pretest-posttest correlation is .5. Assuming the standard deviation of the pool of scores (maximum score = 10) for both X_{pre} and X_{post} is 3.0, 1.5 points represents a gain of one half of a standard deviation or a 15% increase from pretest to posttest. This is the smallest gain for which the sample size allows good power for detection.

If separate tests must be made for each sample, the probability of achieving a significant ($\alpha = .05$) gain under the same conditions is only 46%. The decrease in power is caused by the reduction in number of scores analyzed from 30 to 10. Although gains larger than those hypothesized above are expected, General Physics wants to be able to interpret the data in a consistent and fair manner within the sample size constraints of the field test. To this end, General Physics will use a secondary and less technical analytical technique to measure the significance of pretest-posttest gain when the corelated-t test fails to show a significant gain.

The mean of the X_{post} scores ($\overline{X}_{post}$) will be compared to the mean of the X_{pre} scores ($\overline{X}_{pre}$). If the difference $\overline{X}_{post}$ - $\overline{X}_{pre}$ scores, the gain will be judged significant.

2. Mastery

The degree of mastery of the objectives tested for a student is directly measured by the student's (trainee's) total posttest score (T_{post}). The extent of mastery of a given objective is directly measured by the percent of students (trainees) correctly responding to the test item used for that objective. Both of these measures are related to the effectiveness of the module in meeting the stated objectives and consequently of interest to the curriculum revision team. These measures will be analyzed, together with data obtained from other sources, providing specific information for revision.

It must be emphasized that the two analyses described so far deal only with one dimension of effectiveness, namely, student achievement of those objectives tested by the module posttests. The technique for constructing the module posttests and course pretests does not take into account the practicality, necessity, or sufficiency of the objectives relative to the actual on-the-job knoweldge and skills required of a nuclear QA/QC technician. These issues will be addressed by other dimensions of the data collection and analysis detailed in this field test plan. Also, as described earlier, the modified posttests constructed by General Physics do not necessarily test all of the stated objectives for a module. The posttests test only those objectives for which sufficient information to answer the posttest questions is given in the module and for which an objective type questions can be constructed. As such, the posttests do not measure the interaction of the module with the instructor or the attainment of those objectives that did not meet the criteria for inclusion on the posttests. Thus, the two analyses described above do not, in and of themselves, constitute an analysis of the overall effectiveness of the modules.

3. Other Measures of Module Effectiveness

Additional data concerning the effectiveness of each module will be obtained from the Instructor Module Evaluation forms, Instructor and Student (Trainee) Course Evaluation forms, and the special tear-out section provided with each page of the modules. The effectiveness of a module is not independent from the module's usabiity or relevance. If a module is not usable, or if the content is not relevant, then clearly the module is not effective in the general sense. Thus, all the data collected from the instructors, students (trainees), and other professionals will contribute to the evaluation of a module's effectiveness. The data gathered from the module and course evaluaion forms and the special tear-out sections of the modules will be primarily subjective in nature, with the exception of the responses to the scaled items on the instruments. As such, the data will not lend itself to objective quantification suitable for statistical analysis.

Since the feedback to General Physics from these data collection forms will have a direct influence on the revision of the modules, the data collected will be primarily used for formative evaluation. Thus, the data will be carefully reviewed, organized and synthesized by the field test team to provide a set of general guidelines and a list of specific needs to those responsible for revision. The results of this analysis will be included in the final field test report.

4. Relevance and Usability

Data regarding the relevance of the course materials and the usability of the modules in their present form will be gathered from the Instructor Module Evaluaton form, the Instructor and Student (Trainee) Course Evaluation forms, and the special tear-out sections of the modules. In addition, other non-quantifiable indications of the relevance of the materials will come from the willingness of the professionals at the potential field test sites to participate in the field test and the informal reactions of these professionals to the course materials. Strong negative reaction to participation in the field test because of the content or presentation of the course materials will provide important data for the evaluaton of the relevance of the materials.

Non-quantifiable measures of usability will also be considered as part of the evaluation of this aspect of the course materials. Informal feedback from the professionals at the field test site to the technical consultant and/or other members of the field test team will provide additional indications of the usability of the course materials.

The data analysis for data concerning the relevance and usability of the course materials will be relatively informal. Where possible, data will be quantified and statistically analyzed. All the data on relevance and usability will be reviewed, organized, and synthesized. Conclusions with supporting documentation will be included in the final field test report.

The emphasis of the data analysis scheme is on the provision of formative evaluation data to the curriculum development team to assist them in revision of the modules of the field tested courses and in the development of the modules of the new courses of the nuclear QA/QC Curriculum.

APPENDIX B

FINAL REVISED FIELD TEST PLAN

FINAL REVISED FIELD TEST PLAN

A. OVERVIEW

The following field test plan is designed to be implemented on a course by course basis (i.e., the unit of implementation is a course). This allows maximum flexibility for field testing the seven (7) courses of the Nuclear QA/QC Curriculum within the constraints imposed by the field test sites.

The overall goal of the field test is to field test each course at three (3) different sites. Testing all seven (7) courses at each of three (3) sites is the preferred model and will be implemented where possible. However, academic year calendars and the special needs and constraints of the participating field test sites make it necessary to design a plan that can be implemented on a course by course basis.

Specific field test site commitments and implementation plans are presented in Appendix B. The field test will be conducted to provide information to determine the effectiveness of the course materials as tested (summative evaluation) and to provide specific feedback to the curriculum development team to aid in the revision of the seven (7) tested courses and the initial development of the six (6) additional courses in the Nuclear QA/QC Curriculum (formative evaluation).

The following questions are addressed by this field test:

1. Are the course materials infusible into technical education programs?

2. Are the course materials usable by students (trainees) and instructors in their present form?

3. Are the objectives of the courses' modules achieved by the students?

4. Are the course materials interesting to the students (trainees) and instructors?

Question 1 addresses the relevance of the curriculum itself, question 2 concerns the usability of the materials in their present form, and questions 3 and 4 concern the effectiveness of the materials in terms of achievement and interest.

The existence of the Nuclear QA/QC Curriculum materials to be tested is a direct result of prior efforts to identify specific needs for nuclear technicians, develop a model curriculum (including course descriptions and module listings), and produce specific content modules for some of the courses. However, the relevance of the course materials as they now exist needs to be confirmed by use in an instructional setting. Data will be gathered from the instructors and administrators involved in the field test, via questionnaires and informal de-briefings at the conclusion of their participation in the field test, to confirm the relevance of the course materials.

The usability of the course materials in an actual classroom setting has not, as yet, been documented. To be usable, the course materials must be appropriate to the reading level of the intended audiences, logically sequenced, and technically accurate. In additon, the format must be adaptable to the instructors' teaching styles. Information concerning these dimensions of usability will be gathered through the use of module and course evaluation forms completed by the instructors and an open discussion concerning the quality of the materials by the students at the end of the course. Informal de-briefings of the instructors will also be used to provide insight into specifics not covered by the evaluation forms and to follow-up items on the evaluation forms that need amplification.

The effectiveness of the course materials will be measured through the use of objective referenced pretests and posttests. Two specific analyses will be conducted. One will focus on evidence of student achievement gain between pretest and posttest. The other will deal with evidence of post course student mastery of the course objectives. The specifics of the data analyses are provided later in this document.

B. GENERALIZED IMPLEMENTATION PLAN

The expected field test sites fall into two categories: community college/technical schools and on-site public utility training facilities. The basic organization, needs, time constraints, and other factors involved are sufficiently different between the two categories, as well as within the categories, to necessitate a generalized field test implementation plan that can be modified to suit the special needs of a given site.

One model for a field test is a program-oriented model. A program-oriented field test would provide, at each site, a test of all seven (7) specialized technical courses of the Nuclear QA/QC technician curriculum taught in the recommended sequence concurrently with other courses in the recommended program (see Attachment E to RFP 77-36).

A more flexible approach is a course-oriented field test model which views the Nuclear QA/QC technician programs as a collection of courses that can be taught independently, providing the necessary course prerequisites are satisfied. For example, if a post secondary school or utility wants to use the modules of a course and is satisfied that the prospective students (trainees) have background knowledge and experience equivalent to the stated prerequisites of the course, a course-oriented field test plan allows for that site's participation in the field test. A field test plan that does not provide for such flexibility severely limits the list of potential field test sites; whereas, the usability of the curriculum stands to be increased by a flexible field test plan. Also, a course-oriented model offers the advantage of allowing the program-oriented field test as a special implementation.

The plan that follows is course-oriented to provide needed flexibility. However, General Physics intends to implement the plan in a program-oriented manner if an appropriate field test site can be secured.

The field test will progress through the following stages:

- site selection
- development of implementation schedule
- orientation of instructors
- implementation and data collection
- data analysis
- final report

Site selection includes identification, initial informal contact, formal communication, negotiation, and confirmation. Potential field test sites were identified through several sources: professional contacts of General Physics personnel, a list of community colleges and technical schools offering nuclear programs (list supplied by Mr. William Berndt, BOAE, USOE, DHEW), and direct contact of General Physics by schools interested in participation. At present, General Physics is negotiating with ten (10) potential field test sites. Any confirmed sites and the extent of their commitment at the time this plan is submitted are detailed in Appendix B.

The development of the implementation schedule for each site will be a joint effort by the field test team at General Physics and the appropriate administrators and instructors at the field test site. Specific site visits by members of the field test team, instructor preparation, course start dates, pretest dates, posttest schedule and other pertinent data collection activities will be scheduled. It is anticipated that the implementation schedules will vary from one field test site to another.

The orientation of instructors will familiarize the instructors with specific course materials, provide answers to technical questions by a General Physics technical consultant, assist instructors in gathering and preparing special materials, and inform the instructors of the specific data collection requirements of the field test plan. It is expected that a member of the field test team and/or a technical consultant will visit the field test site during this period. Instructor background information will be obtained during the on-site visit.

The implementation and data collection phase of the field test will begin with the first class meeting of students with the instructor. This phase covers the actual teaching of the course and includes the collecton of student (trainee) background, pretest, posttest, and module and course evaluation data. The implementation phase ends with the completion and return of all data collection instruments to General Physics.

Data analysis will be conducted by the field test team at General Physics. . Details are provided in section D of this document.

The final report will be written upon completion of data analysis for the last field test site completing and returning required data. This report will be submitted to the Bureau of Occupational and Adult Education, USOE, DHEW at the conclusion of the contract period.

C. DATA COLLECTION

To obtain a description of the field test subjects, as well as quantifiable data to address the relevance, usability and effectiveness of the field tested courses of the Nuclear QA/QC curriculum, several types of data will be used and various techniques of data collection will be employed. Structured response forms will be used to collect data on student (trainee) and instructor academic background and experience, student (trainee) and instructor evaluations of each course, and instructor evaluations of each module. Objective-type pretests and posttests that parallel the learning objectives of the modules/courses will be used to collect student (trainee) achievement data.

Sample description is a necessary part of all field tests. The generalization of the conclusions based on the field test results is limited to the representativeness of the sample. For this reason, data concerning the curriculum's usability must be collected and presented in the final field test report. The instructors will complete an Instructor Academic Background and Prior Experiences Survey and be asked to write a description of the academic backgrounds and prior experiences of the students in the class.

The relevance of the curriculum as well as its usability are, in part, functions of individual perceptions. The instructors and students (trainees) must perceive the content to be relevant to career goals. Also, for the materials to be usable, the instructors and students (trainees) must find the format of the course materials to be adaptable to their teaching or learning styles. The purpose of collecting data on usability and relevance is two-fold: to directly obtain summative data for the curriculum as field tested and to indirectly gather formative data for revision of the field test courses. The dimensions of usability and relevance addressed include the clarity of presentaiton, difficulty of concepts, logical flow of subject matter, format of materials, and appropriateness of exercises and procedures.

The structured instruments to collect this data - the Instructor Module Evalaution Form, and the Instructor Course Evaluation Form, are given in Appendix C. In addition, an open unstructured discussion of the materials, by the students, will take place at the end of each course.

Measures of the effectiveness of the course materials will be obtained through the use of pretests and posttests designed to parallel the learning objectives of the courses. Each module currently contains a posttest written by the original author(s) of the module. Many of the questions written by the original author(s) are not in an objective format. As many of these questions as possible will be modified to an objective format. These modifications are necessary to maximize the reliability of pretest and posttest scores and to reduce the amount of testing time reqired. Questions from the original module posttest will be included in the modified posttest if they meet the following criteria:

- The question pertains to a stated module objective and can be modified to an objective format or the question is already in an objective format.
- The answer to the question can be found in the textual material of the module being tested.

No judgement of the infusibility, relevance, or usability of either the objectives or test questions written by the original author(s) will be made.

Answer keys with scoring instructions will be constructed for each module posttest and supplied to the instructors.

Any question that is part of the original module test but cannot be modified to an objective format without losing the intent of the question will be supplied to the instructors. Provision for using questions other than those on the field test posttest is made because General Physics does not wish to constrain the instructor to use only the objective type posttest for evaluation of student progress.

For each course, a single representative pretest will be constructed by a stratified random selection of items from the collected module posttests for the course. The stratification will insure that some objectives from each of the modules will be pretested allowing the use of pretest data in an analysis of pretest-posttest gain as a measure of module as well as total course effectiveness. The pretest will be prepared so that they may be administered in one class period or 45 minutes.

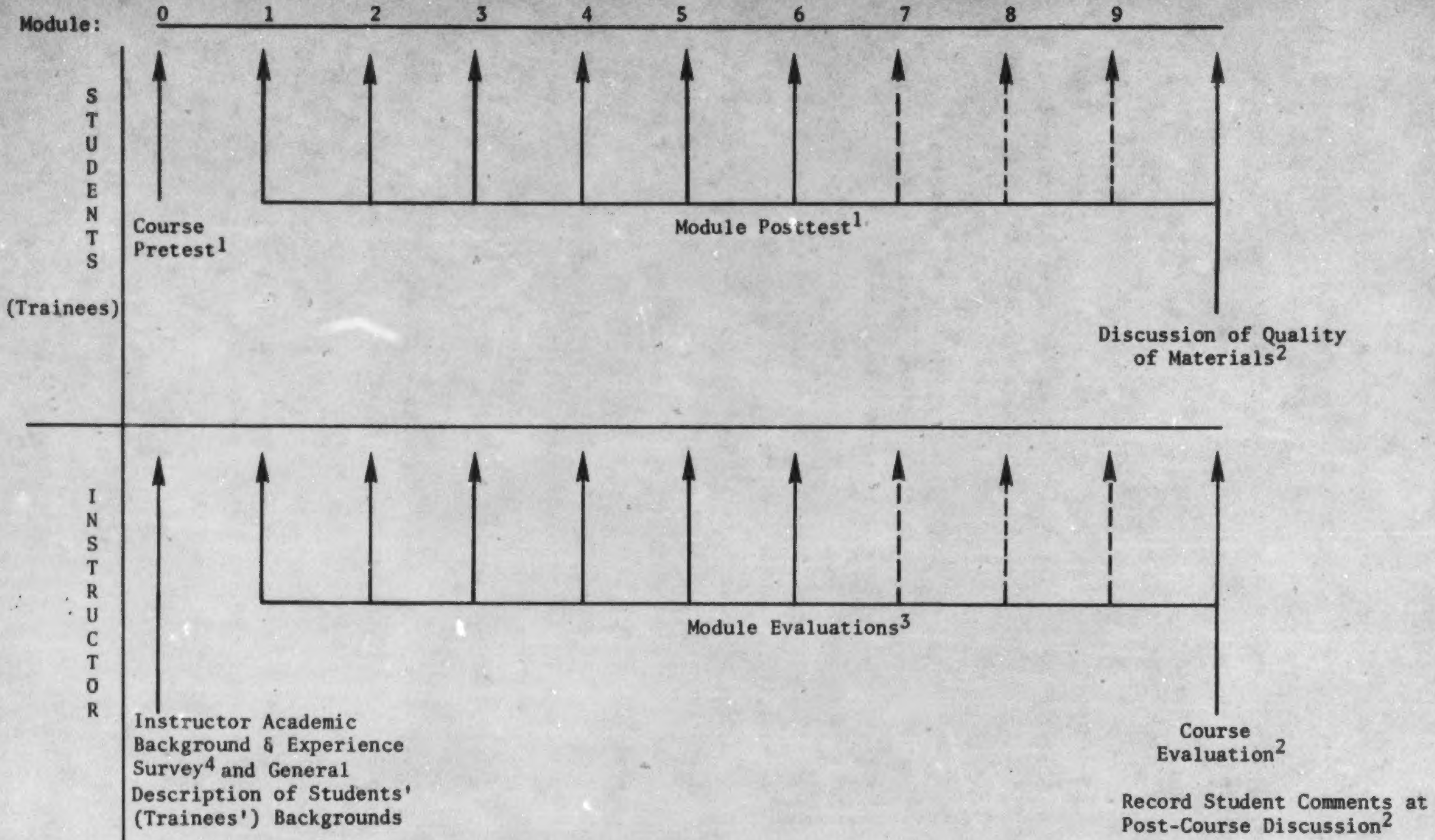
Sample module posttests with answer keys, a course pretest with answer key and instructions for use are given in Appendix C.

A schematic representation of the collection of the necessary data is given in the following diagram. This digram represents the data collection at a post secondary school implementation of the field test plan. The actual administration of posttests will vary according to the completion time of each module and the number of modules. Also, the length of the course will expand or shorten the time schedule as appropriate.

D. DATA ANALYSIS TECHNIQUES

For summative evaluation of the effectiveness of the presentation of the objectives tested on the posttest of a module, the following scores will be used:

- A pretest score (X_{pre}) based on item scores from the course pretest items that match items on the module posttest.
- A posttest score (X_{post}) based on item scores from the module posttest for those items that match coure pretest items.
- Posttest item scores.
- A posttest score (T_{post}) based on all item scores from the posttest.


Module:
0
1
2
3
4
5
6
7
8
9
STUDENTS
(Trainees)
Course Pretest[1]
Module Posttest[1]
Discussion of Quality of Materials[2]
INSTRUCTOR
Instructor Academic Background & Experience Survey[4] and General Description of Students' (Trainees') Backgrounds
Module Evaluations[3]
Course Evaluation[2]
Record Student Comments at Post-Course Discussion[2]

1. Returned to General Physics as soon as completed in the pre-paid envelope provided.
2. Completed after the last posttest and returned to General Physics with the last posttest.
3. Completed at conclusion of each module and returned with module posttests.
4. Return with pretests.

GENERALIZED DATA COLLECTION SCHEDULE
COURSE FIELD TEST

The scores from the matching pretest and posttest items (X_{pre} and X_{post}) will be analyzed to assess module pretest-posttest gain. The posttest item scores and the total posttest score (T_{post}) will be used to assess student mastery of the objectives tested on the module posttest.

1. Pretest-Posttest Gain

The pretest-posttest gain for a module will be analyzed using a correlated-t statistic. The samples of students (trainees) from all field test sites using the module will be pooled, provided that the pretest means for the samples are not significantly different. If any pretest mean scores for a sample are significantly different from the other samples, a separate test will be made for the different sample. The use of pooled scores maximizes the power of the statistical test. With pooled scores for 30 subjects (3 field test sites x 10 subjects per site), the probability of achieving a statistically significant ($\alpha = .05$) gain from pretest to posttest (i.e., the power of the statistical test) is 86% when the true population gain is 1.5 points and the pretest-posttest correlation is .5. Assuming the standard deviation of the pool of scores (maximum score = 10) for both X_{pre} and X_{post} is 3.0, 1.5 points represents a gain of one half of a standard deviation or a 15% increase from pretest to posttest. This is the smallest gain for which the sample size allows good power for detection.

If separate tests must be made for each sample, the probability of achieving a significant ($\alpha = .05$) gain under the same conditions is only 46%. The decrease in power is caused by the reduction in number of scores analyzed from 30 to 10. Although gains larger than those hypothesized above are expected, General Physics wants to be able to interpret the data in a consistent and fair manner within the sample size constraints of the field test. To this end, General Physics will use a secondary and less technical analytical technique to measure the significance of pretest-posttest gain when the corelated-t test fails to show a significant gain.

The mean of the X_{post} scores ($\bar{X}_{post}$) will be compared to the mean of the X_{pre} scores ($\bar{X}_{pre}$). If the difference $\bar{X}_{post}$ - $\bar{X}_{pre}$ scores, the gain will be judged significant.

2. Mastery

The degree of mastery of the objectives tested for a student is directly measured by the student's (trainee's) total posttest score (T_{post}). The extent of mastery of a given objective is directly measured by the percent of students (trainees) correctly responding to the test item used for that objective. Both of these measures are related to the effectiveness of the module in meeting the stated objectives and consequently of interest to the curriculum revision team. These measures will be analyzed, together with data obtained from other sources, providing specific information for revision.

It must be emphasized that the two analyses described so far deal only with one dimension of effectiveness, namely, student achievement of those objectives tested by the module posttests. The technique for constructing the module posttests and course pretests does not take into account the practicality, necessity, or sufficiency of the objectives relative to the actual on-the-job knoweldge and skills required of a nuclear QA/QC technician. These issues will be addressed by other dimensions of the data collection and analysis detailed in this field test plan. Also, as described earlier, the modified posttests constructed by General Physics do not necessarily test all of the stated objectives for a module. The posttests test only those objectives for which sufficient information to answer the posttest questions is given in the module and for which an objective type questions can be constructed. As such, the posttests do not measure the interaction of the module with the instructor or the attainment of those objectives that did not meet the criteria for inclusion on the posttests. Thus, the two analyses described above do not, in and of themselves, constitute an analysis of the overall effectiveness of the modules.

3. Other Measures of Module Effectiveness

Additional data concerning the effectiveness of each module will be obtained from the Instructor Module Evaluation forms, Instructor Course Evaluation forms, and the post-course open discussion. The effectiveness of a module is not independent from the module's usabiity or relevance. If a module is not usable, or if the content is not relevant, then clearly the module is not effective in the general sense. Thus, all the data collected from the instructors, students (trainees), and other professionals will contribute to the evaluation of a module's effectiveness. The data gathered from the module and course evaluaion forms and the special tear-out sections of the modules will be primarily subjective in nature, with the exception of the responses to the scaled items on the instruments. As such, the data will not lend itself to objective quantification suitable for statistical analysis.

Since the feedback to General Physics from these data collection forms will have a direct influence on the revision of the modules, the data collected will be primarily used for formative evaluation. Thus, the data will be carefully reviewed, organized and synthesized by the field test team to provide a set of general guidelines and a list of specific needs to those responsible for revision. The results of this analysis will be included in the final field test report.

4. Relevance and Usability

Data regarding the relevance of the course materials and the usability of the modules in their present form will be gathered from the Instructor Module Evaluaton form, the Instructor Course Evaluation forms, and the post course open discussions. In addition, other non-quantifiable indications of the relevance of the materials will come from the willingness of the professionals at the potential field test sites to participate in the field test and the informal reactions of these professionals to the course materials. Strong negative reaction to participation in the field test because of the content or presentation of the course materials will provide important data for the evaluaton of the relevance of the materials.

Non-quantifiable measures of usability will also be considered as part of the evaluation of this aspect of the course materials. Informal feedback from the professionals at the field test site to the technical consultant and/or other members of the field test team will provide additional indications of the usability of the course materials.

The data analysis for data concerning the relevance and usability of the course materials will be relatively informal. Where possible, data will be quantified and statistically analyzed. All the data on relevance and usability will be reviewed, organized, and synthesized. Conclusions with supporting documentation will be included in the final field test report.

The emphasis of the data analysis scheme is on the provision of formative evaluation data to the curriculum development team to assist them in revision of the modules of the field tested courses and in the development of the modules of the new courses of the nuclear QA/QC Curriculum.

Instructor Academic Background and Prior Experience Survey

(Form A)

Name________________________ Date__________________

Sex (M or F)________________

Company or Institution____

Current Position____________________________

I. Academic Background

A. Did you graduate from high school?____________

B. Did you attend a two-year or a four-year college?____________.

If yes, what was your major field?_____________

Did you graduate?____________

If yes, please give the type of degree (AA, BS, etc.) and the date (year) it was conferred._____________

If not, how many credits did you complete in your major field of study?____________

II. Professional Society Membership

Please list your current professional society memberships. For each society listed, indicate any special office you currently hold.

Society	Office

III. Nuclear Experience

A. Do you have military nuclear power experience?

If so, please indicate the service, type of assignment and number of years experience for each assignment.

Service	Assignment	# Years

Form A (Continued)

III. Nuclear Experience (continued)

B. Do you have conventional (non-nuclear) power plant experience?___________

If so, please indicate the type of position and number of years experience for each position held.

Position	# Years

C. Do you have commercial nuclear power plant experience?_____________

If so, please indicate the type of position and number of years experience for each distinct position held.

Position	# Years

D. Do you have specific Quality Assurance?Quality Control experience?__________

In what capacity? (You may reference position listed above.)

Position	# Years

E. Do you have a Reactor Operator's License?_________________

F. Do you have a Senior Reactor Operator's License?________________

Form A (Continued)

G. Do you have nuclear experience in areas other than power generation (medicine, weapons, geology, etc)?____________________________

If so, please indicate the type of experience, company or service, and number of years for each type of experience.

Type	Company or Service	# Years

IV. Teaching Experience

Please describe your prior teaching experience by indicating the level and type of courses taught and the number of times taught for each type. (e.g. Undergraduate Mathematics 3, On the Job Training Radiation Physics 2, High School Physics 1, etc.)

Level	Type of Course	# Times Taught

V. Interest in Participation in Field Test

Priefly explain why you are interested in participating in a field test of nuclear QA/QC curriculum materials.

Instructor Module Evaluation

(Form C)

Module ______________________ Instructor Name ____________________

Date ________________________ Field Test Site ____________________

I. General Evaluation

For each statement below, circle the letter(s) below the statement that indicate(s) your response to that statement. Please feel free to comment on your response in the space provided to the right (use additional sheets if necessary). If a question does not apply to the module you are evaluating, leave it blank.

Key: SA = Strongly Agree A = Agree U = Undecided D = Disagree
SD = Strongly Disagree

Comments

1. The concepts developed in the module are relevant to the type of nuclear technician being trained by this course.

   SA A U D SD

2. The concepts in the module are developed to sufficient depth for the type of nuclear technician being trained by this course.

   SA A U D SD

3. The reading level of the materials is appropriate for the nuclear technology students in this course.

   SA A U D SD

4. The format of the modules is acceptable for use as curriculum material in this type of course.

   SA A U D SD

5. The stated prerequisites for the module are sufficient preparation for the concepts developed.

   SA A U D SD

6. The presentation of the concepts is clear.

   SA A U D SD

7. The subject matter matches the stated objectives for the module.

   SA A A D SD

Form C (Continued)

Comments

8. The concepts presented are at an appropriate level for nuclear technology students.

SA A U D SD

9. The flow of concepts developed in the module is logical.

SA A U D SD

10. The technical content of the module is accurate.

SA A U D SD

II. Specific Comments

Your comments concerning specific aspects of the module are needed for revision of the module. Add additional sheets if more space is required.

1. a. How much class time did you spend on this module?

   b. How much laboratory time, if any?

   c. If "Additional Questions" were provided to you with the module posttest, did you use any of them for evaluating student performance?

   d. Did you add questions of your own to the module posttest? If so, why?

2. Please comment on the overall strengths and weaknesses of the module.

3. Are there sections of the module or objectives that should be deleted? If so, which ones?

4. While teaching the content of the module, did you feel that you had to elaborate further on topics covered in the module? If so, which ones? How much elaboration did you do?

5. Did you find it necessary to add topics or terms to the content of the module? If so, what did you add? Why?

6. Were there terms or topics in the module that caused the students particular difficulty? If so, which ones?

7. Does the module provide adequate coverage and explanation of the concepts to be used by students in an independent study mode of instruction? If not, why not?

8. How could this module be improved?

Instructor Course Evaluation

(Form D)

Course ____________________ Instructor Name ____________________

Date ____________________ Field Test Site ____________________

The purpose of this evaluation instrument is to elicit your overall reactions to the materials you have used to teach the course. This course evaluation addresses broader issues than the module evaluations you-have already completed. It is concerned with the course as a whole.

Directions: Indicate your answer to each of the questions below by checking the appropriate response or by filling in the blank provided. Please feel free to add additional comments.

Comments

1. a. . Are the topics covered relevant to the career needs of all nuclear technicians?

☐ Yes ☐ No

b. If not, are there specific nuclear technologies for which the topics covered are appropriate? Please list.

☐ Yes ☐ No

2. Does this course fit into your present curriculum?

☐ Yes ☐ No

3. a. Did your company or institution offer this course before the current offering?

☐ Yes ☐ No

b. If yes, what textual materials did you use previously?

4. Is the general quality of the course materials good?

☐ Yes ☐ No

5. Is the presentation of concepts clear?

☐ Yes ☐ No

Form D (Continued)

Comments

6. Is the technical content of the course materials accurate?

   ☐ Yes ☐ No

7. a. Would you use these course materials as they are again?

   ☐ Yes ☐ No

   b. If not, would you consider using a revised version?

   ☐ Yes ☐ No

   c. If you would use a revised version, what is the most critical aspect of the needed revision?

   d. If the materials were suitably revised, how much do you think the materials would be worth (in dollars) per student?

8. Is the course a worthwile course for nuclear technicians?

   ☐ Yes ☐ No

POST COURSE CLASS DISCUSSION OF CURRICULUM MATERIALS

COURSE: ______________________________

DATE: ______________ INSTRUCTOR: ______________

COLLEGE OR COMPANY: ______________________________

Please assess and record your perceptions of the students' (trainees') general reaction to as many of the questions below as possible during the post-course open discussion of the materials. Written comments from the students are welcome if the students wish to submit them (signed or unsigned). Our intent is to obtain an estimate of the quality of the materials from the students' (trainees') point of view. This feedback will be used by the curriculum revision team. Our DHEW-approved field test plan prohibits the instructor from actively leading this discussion or asking specific questions of the students.

1. Is the presentation of the concepts in the written material clear?

2. Are the course materials well written?

3. Is the format of the modules (objectives + text + exercises + procedures) appropriate for a course of this type?

4. Do you like having the objectives stated at the beginning of each module?

5. Are the module tests a fair test of the module objectives?

6. Do you think the content of the course modules is appropriate for nuclear technicians?

7. Do the modules provide sufficient information for doing the exercises?

8. Are the stated prerequisites for the modules accurate (i.e., necessary and sufficient?

9. Do you think the course materials are good? Why, or why not?

10. Do you think the materials could be used effectively in an independent study format (i.e., without an instructor)?

11. How can the modules be improved?

GENERAL PHYSICS CORPORATION

1000 CENTURY PLAZA
COLUMBIA, MARYLAND 21044
301-730-4055 — 301-953-3240

STUDENT (TRAINEE) DATA RELEASE AUTHORIZATION

I hereby authorize the release of my pretest and posttest scores to General Physics Corporation, for the purposes of evaluating the effectiveness of the nuclear technicians curriculum materials being field tested. I understand that my name will be removed and replaced with a numerical code, known only to my institution.

____
Signature

____
Date

____
College or Corporation

APPENDIX C

FIELD TEST SITES

A. **Potential sites identified for field testing a Nuclear QA/QC course prior to contract award:**

1. **Texas State Technical Institute**
   James Connally Campus
   Waco, Texas 76705

2. Midlands Technical Education Center
   316 Beltline Boulevard
   Columbia, South Carolina 29250

3. South Carolina Electric & Gas Company
   Virgil B. Sumner Nuclear Plant
   Training Department
   Jenkenville, South Carolina 29065

4. TVA Power Production Training Center
   Sequoyah Nuclear Plant
   P.O. Box 2000
   Daisy, Tennessee 37319

B. Potential field test sites expressing interest in participating in the field test after being contracted by General Physics:

Post Secondary Educational Institutions

1. Community College of Beaver County
   Monaca, Pennsylvania

2. Tri-County Technical College
   Pendleton, South Carolina

3. Texas State Technical Institute
   Waco, Texas

4. Cincinnati Technical College
   Cincinnati, Ohio

5. Central Florida Community College
   Ocala, Florida

6. Roane State Community College
   Rochwood, Tennessee

7. Terra Technical College
   Fremont, Ohio

8. Chattanooga State Technical Community College
   Chattanooga, Tennessee

Public Power Generation Utilities

9. South Carolina Electric and Gas Company
   Columbia, South Carolina

10. Baltimore Gas and Electric Company
    Lusby, Maryland

11. General Public Utilities
    Reading, Pennsylvania

C. Potential field test sites declining to field test QA/QC courses:

Site	Reason(s) Given for Declining
1. Community College of Beaver County Monaca, Pennsylvania	a. Content of course materials too ruimentary. b. Course 1 total content would consume only 6 hours of class time. c. The approach is illogical.
2. Hartford State Technical College Hartford, Connecticut	a. Satisfied with their Nuclear Technology curriculum. b. Cannot fit QA/QC Technician materials into their curriculum.
3. Terra Technical College Fremont, Ohio	a. Satisfied with their present Nuclear Technology curriculum. b. Don't want to specialize in Nuclear QA/QC. c. Lack of fit of modules into their present curriculum. d. Consider modules are more suitable for an institute that has not developed a Nuclear Technology program. e. Consider modules are inadequate for their present curriculum.
4. Wentworth Institute Boston, Massachusetts	a. Dropped their Nuclear Technology Program, due to insufficient number of students.
5. Charles County Community College, LaPlata, Maryland	a. Do not have, or desire to have at this time, a Nuclear Technology program.

6.	Prince George's Community College, Largo, Maryland	a.	Do not have, or desire to have at this time, a Nuclear Technology program.
7.	Aiken Technical Education Center, Aiken, South Carolina	a.	Dropped their nuclear technology program.
8.	Forence-Darlington Technical College, Florence, South Carolina	a.	Do not have an appropriate program for infusion of nuclear QA/QC technician speciality courses.
9.	Midlands Technical College Columbia, South Carolina	a.	Dropped their nuclear technology program due to insufficient number of students.
10.	Pennsylvania State Univ. Altoona Campus, Altoona, Pennsylvania	a.	Do not have an appropriate program for infusion of nuclear QA/QC technicians speciality courses.
11.	Pennsylvania State Univ. Hazelton Campus, Hazelton, Pennsylvania	a.	Do not have an appropriate program for infusion of nuclear QA/QC technician speciality courses.
12.	Central Florida Community College, Ocala, Florida	a.	Budget cuts have made it impossible to use new materials.
13.	Amarillo College Amarillo, Texas	a.	Do not have an appropriate program for infusion of nuclear QA/QC technician specialty courses.
14.	Shoreline Community College, Seattle, Wash.	a.	Have arranged to send nuclear technology students to University of Washington.
		b.	Do not desire to have own nuclear technology curriculum.
15.	SUNY Agricultural and Technical College, Alfred, New York	a.	Do not have an appropriate program for infusion of nuclear QA/QC technician specialty courses.
16.	Wake Technical Institute Raleigh, North Carolina	a.	Do not have an appropriate program for infusion of nuclear QA/QC technician specialty courses.
17.	Duke Power Company Charlotte, North Carolina	a.	Materials are more suitable for post secondary schools than nuclear utility.
18.	Baltimore Gas & Electric Baltimore, Maryland	a.	Do not have enough students to participate in field testing.

19.	General Public Utilities Reading, Pennsylvania	a.	Existing training programs are adequate.
20.	Clackamas Community College Oregon City, Oregon	a.	Do not have a suitable program for infusion of nuclear QA/QC technician specialty courses.
21.	Community College of Allegheny County, South West Mifflin, Pennsylvania	a.	Do not have a suitable program for infusion of nuclear QA/QC technician specialty course
22.	Conners State College Warner, Oklahoma	a.	Do not have a nuclear program.
23.	Kirkwood Community College Cedar Rapids, Iowa	a.	Do not have a nuclear program.
24.	Middlesex County College Edison, New Jersey	a.	Do not have a nuclear program.
25.	Northeastern Oklahoma Agricultural & Medical College, Miami, Oklahoma	a.	Do not have a nuclear program.
26.	Richland Community College Decatur, Illinois	a.	Do not have a nuclear program.
27.	San Jose City College San Jose, California	a.	Do not have a nuclear program.
28.	Skagit Valley Community College, Mount Vernon, Wash.	a.	Do not have a nuclear program.
29.	South Oklahoma City Junior College, Oklahoma, City, OK	a.	Do not have a nuclear program.
30.	Valencia Community College Orlando, Florida	a.	Do not have a nuclear program.
31.	Washtenaw Community College Ann Arbor, Michigan	a.	Do not have a nuclear program.
32.	Westmoreland County Community College, Youngwood, PA	a.	Do not have a nuclear program.
33.	Texas State Technical Institute Waco, Texas	a.	Do not have a suitable program for infusion of courses.
		b.	Certain modules are of interest but no single course as a whole.

34.	Chabot College Hayward, California	a.	Due to retirement of key instructor, have only part time instructors in Technical Engineering.
		b.	Health Physics program could use Courses 1, 2, and 11, but enrollment in this program is poor.
		c.	Do not have other suitable programs.
35.	Albany Junior College Albany, New York	a.	Do not have a nuclear program.
36.	Roane State Community College Harriman, Tennessee	a.	Will begin a nuclear program in fall of 1979, at earliest.
37.	Central VA Community Collete Lynchburg, Virginia	a.	Dropped nuclear program.
38.	Bronx Community College	a.	Nuclear program will not begin until 1980 if at all.
39.	Richland Community College Decatur, Illinois	a.	Nuclear program will begin in fall, 1979.
40.	Bergen Community College Paramus, New Jersey	a.	No relevant courses of study, nuclear or non-nuclear.
41	Mohawk Valley Utica, New York	a.	Interested in neither Process Instrumentation nor Introduction to QA/QC.
42.	Broome Tech. Comm. College Binghamton, New York	a.	Earliest course implementation would be fall, 1979 term.
43.	Joliet Jr. College Joliet, Illinois	a.	Nuclear Program, if it begins in 1979, will initially be for reactor operators only.
44.	Union College Cranford, New Jersey	a.	Course materials are inappropriate to their curriculum levels (too elementary)
45.	Arkansas State Polytechnical School, Russellville, Arkansas	a.	Do not have a suitable curriculum for field testing these courses.
46.	Catonsville Community College Catonsville, Maryland	a.	Cannot use material in course because they are too lengthy for schedule and too nuclear oriented.
47.	McComb County Community College Warren, Michigan	a.	Do not have a suitable curriculum for field testing these courses.
		b.	Satisfied with their present curriculum

48.	Hudson Valley Community College, Troy, New York	a. Do not have suitable curriculum for field testing these courses.
49.	Motlow State Community College, Tullahoma, TN	a. Do not have suitable curriculum for field testing these courses.
50.	Delta College University Center, Michigan	a. No current program which is suitable. b. Would desire certain courses at future time.
51.	Muskegon Community College Muskegon, Michigan	a. Do not have a suitable curriculum for field testing these courses.
52.	Cuyahoga Community College Cleveland, Ohio	a. Do not have a suitable curriculum for field testing these courses.
53.	Dundalk Community College Dundalk, Maryland	a. Do not have a suitable curriculum for field testing these courses.

APPENDIX D

ANALYSIS OF PRETEST - POSTTEST GAIN

COURSE	SITE	MODULE	N	PRE MEAN	POST MEAN	GAIN	PRE S.D.	t	SIG.
1	CSTC	1	13	7.6	11.6	4.0	1.3	12.40	**
		2	13	3.9	7.1	3.2	2.0	6.19	**
		3	13	4.6	11.4	6.8	2.4	10.78	**
		4	12	6.7	10.2	3.5	1.6	8.07	**
		5	12	3.6	8.8	5.2	1.4	11.94	**
		6	12	5.3	13.4	8.1	3.0	9.32	**
	SCE&G	1	12	10.1	11.4	1.3	1.2	3.73	**
		2	12	5.4	7.4	2.0	1.4	4.43	**
		3	12	4.9	10.9	6.0	1.6	10.85	**
		4	12	7.6	10.5	4.9	1.8	5.25	**
		5	12	4.8	7.2	2.4	2.5	3.47	**
		6	12	8.5	11.3	2.8	2.3	4.85	**
	TSTI-H	1	15	3.6	10.7	7.1	2.0	15.04	**
		2	15	1.9	6.1	4.2	1.4	10.65	**
		3	15	3.8	11.5	7.7	2.4	14.38	**
		4	15	5.2	9.9	4.7	2.9	5.86	**
		5	15	5.9	8.5	2.6	1.9	4.98	**
		6	15	6.1	13.1	7.0	1.4	17.47	**
2	CSTC	1	14	.3	2.5	2.2	.6	9.28	**
		2	14	.9	3.6	2.7	.8	9.73	**
		3	13	1.1	4.9	3.8	1.0	9.43	**
		4	13	.8	4.6	3.8	.8	11.14	**
		5	13	1.0	3.0	2.0	.7	10.20	**
		6	13	1.0	5.9	4.9	.9	11.75	**
	SCE&G	1	9	.9	2.2	1.3	.8	3.57	**
		2	9	2.3	3.3	1.0	1.1	3.75	**
		3	9	.9	4.0	3.1	1.1	6.79	**
		4	9	1.1	4.3	3.2	1.1	6.54	**
		5	10	1.7	2.5	.8	1.0	2.70	**
		6	10	1.8	7.1	5.3	1.4	12.67	**
	TSTI-H	1	12	.1	2.3	2.2	.3	8.10	**
		2	12	.8	3.6	2.8	.8	6.77	**
		3	12	.2	4.7	4.5	.4	11.88	**
		4	12	1.1	5.1	4.0	1.1	12.75	**
		5	12	1.6	3.0	1.4	1.2	3.96	**
		6	12	2.3	8.1	7.8	2.0	9.13	**

COURSE	SITE	MODULE	N	PRE MEAN	POST MEAN	GAIN	PRE S.D.	t	SIG.
3	SCE&G	1	9	4.8	10.1	5.3	3.7	4.09	**
		2	9	1.6	4.0	2.4	2.1	4.10	**
		3	11	2.1	8.0	5.9	2.3	7.91	**
		4	11	1.1	4.5	3.4	1.3	4.80	**
		5	9	1.3	7.6	6.3	1.7	10.30	**
		6	9	2.0	3.1	.9	1.8	1.75	✓
		7	-	-	-	-	-		
		8	-	-	-	-	-		
11	CSTC	1	14	1.6	2.5	.9	1.2	3.63	**
		2	14	2.6	6.6	4.0	2.6	5.76	**
		3	14	1.2	8.4	7.2	8.4	12.76	**
		4	14	5.1	8.1	3.0	8.1	5.35	**
		5	14	2.9	10.7	6.8	10.7	6.29	**
		6	14	1.9	5.4	3.5	5.4	7.53	**
		7	14	.6	3.8	3.2	3.8	10.55	**
		8	14	1.4	5.3	.9	5.3	7.64	**
	TSTI-H	1	13	.2	1.4	1.2	.4	8.89	**
		2	13	.4	6.3	5.9	.6	17.63	**
		3-8	POSTTESTS NOT GIVEN						
14	TSTI-H		NO PRETEST GIVEN						
15	TCTC	1	12	.8	10.7	9.9	1.0	14.93	**
		2	12	.2	1.6	1.4	.4	5.41	**
		3	12	.4	2.9	2.5	.7	4.91	**
		4	12	1.1	1.5	.4	1.2	1.18	NS
		5	12	.1	1.2	1.1	.3	5.54	**
		6	11	.4	3.5	3.1	.5	6.82	**
		7	11	.1	1.0	.9	.3	5.42	**
		8	9	.6	5.1	4.5	.7	9.98	**
	CPCC	1	17	.2	6.7	6.5	.5	6.90	**
		2	13	.0	1.5	1.5	.0	7.15	**
		3	13	.2	2.2	2.0	.6	4.31	**
		4	13	.4	5.9	5.5	.9	12.79	**
		5	12	.0	1.7	1.7	.0	11.73	**
		6	13	.2	3.6	3.4	.4	9.67	**
		7	13	.0	.8	.8	.0	6.32	**
		8	12	.0	6.2	6.2	.0	8.04	**

COURSE	SITE	MODULE	N	PRE MEAN	POST MEAN	GAIN	PRE S.D.	t	SIG.
27	HFCC-1	1	11	3.4	6.9	3.5	2.0	1.90	✓
		2	11	3.9	6.8	2.9	2.6	4.01	**
		3	10	.8	2.1	1.3	1.0	3.48	**
		4	11	.4	2.1	1.7	.7	3.48	**
		5	10	.7	4.6	3.9	.8	13.92	**
		6	11	.1	2.2	2.1	.3	8.25	**
		7	10	.1	.2	.1	.3	.56	NS
		8	10	.0	1.7	1.7	.0	2.12	*
	HFCC-2	1	8	5.0	15.9	10.8	1.3	4.70	**
		2	7	4.3	8.3	4.0	2.2	4.11	**
		3	5	.8	3.4	2.6	.8	5.22	**
		4	2	.0	3.0	3.0	.0	3.00	*
		5	3	.3	4.3	4.0	.6	14.70	**
		6	1	.0	2.0	2.0	.0	0.00	NTP
		7	2	.0	1.0	1.0	.0	1.00	NS
		8	2	.0	5.5	5.5	.0	11.00	**

** = Statistically significant at the $\alpha = 0.05$ level of significance
* = Statistically significant at the $\alpha = 0.01$ level of significance
NS = Not Significant
NTP = No Test Possible
✓ = Gain of at least one-half the pretest standard deviation

APPENDIX E

ANALYSIS OF POSTTEST ITEM MASTERY

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 1 - MODULE 1

		SITE		
ITEM NO.	POSTTEST IDENT. #	1	3	5
1	1	100	100	100
2	2	100	100	100
3	3	100	100	93
4	4	100	100	100
5	5	93	92	80
6	6	100	85	80
7	7	76	90	87
8	8	93	100	80
9	9	100	92	100
10	10	71	92	93
11	11	100	92	100
12	12	86	85	60
13	13	100	92	100
14	14	100	92	87
15	15	90	81	89
# Students (Trainees)		14	13	15

PERCENT CORRECT FOR POSTTEST ITEMS

COURSE 1 - MODULE 2

		SITE		
ITEM NO.	POSTTEST IDENT. #	1	3	5
1	1	100	100	100
2	2	93	100	87
3	3	100	100	100
4	4	100	85	80
5	5	100	85	80
6	6	93	100	100
7	7	71	92	60
8	8	86	100	73
9	9	100	77	80
10	10	79	77	33
11	11	79	38	67
12	12	93	92	73
13	13	92	82	91
14	14	70	60	100
15	15	86	77	80
16	16	79	100	67
17	17	93	92	73
18	18	75	96	60
19	19	64	92	40
20	20	75	67	88
21	21	93	92	73
22	22	79	77	93
23	23	64	92	87
24	24	65	77	74
# Students (Trainees)		14	13	15

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 1 - MODULE 3

		SITE		
ITEM NO.	POSTTEST IDENT. #	1	3	5
1	1	100	100	100
2	2	100	100	87
3	3	100	100	100
4	4	100	85	87
5	5	93	92	80
6	6	79	54	40
7	7	98	100	95
8	8-1	100	100	100
9	8-2	93	46	100
10	8-3	86	100	100
11	8-4	21	15	100
12	8-5	100	100	100
13	8-6	36	23	100
14	8-7	100	100	100
15	8-8	93	85	100
16	8-9	93	92	100
17	8-10	21	0	100
18	9-1	71	77	80
19	9-2	71	77	80
20	9-3	71	77	73
21	9-4	71	77	80
22	9-5	71	77	73
23	9-6	71	77	73
24	10-1	86	92	93
25	10-2	86	85	67
26	10-3	86	100	93
27	11	86	91	99
28	12	91	73	90
29	13	82	69	87
30	14	57	85	80
31	15	64	15	67
32	16	57	85	47
# Students (Trainees)		14	13	15

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 1 - MODULE 4

		SITE		
ITEM NO.	POSTTEST IDENT. #	1	3	5
1	1	77	100	67
2	2	92	100	100
3	3	100	100	100
4	4	92	92	100
5	5	100	100	100
6	6	100	100	100
7	7	85	92	80
8	8	100	100	87
9	9	85	69	80
10	10	100	100	93
11	11	92	92	87
12	12	100	100	93
13	13	85	46	67
14	14	38	54	80
15	15	31	0	93
16	16	15	9	53
17	17	63	46	93
18	18	13	0	73
19	19	77	31	67
# Students (Trainees)		13	13	15

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 1 - MODULE 5

		SITE		
ITEM NO.	POSTTEST IDENT. #	1	3	5
1	1-a	100	69	73
2	1-b	92	54	100
3	1-c	77	77	80
4	1-d	100	100	93
5	1-e	85	54	100
6	1-f	85	54	80
7	2-a	77	92	93
8	2-b	100	100	93
9	2-c	92	77	87
10	2-d	100	100	93
11	2-e	92	92	87
12	2-f	85	77	93
13	3	88	82	85
14	4	85	85	87
15	5	85	100	100
16	6-a	77	85	67
17	6-b	92	85	93
18	6-c	62	31	20
19	6-d	85	85	80
20	6-e	85	62	93
21	6-f	77	77	73
22	6-g	85	62	87
23	7-a	100	77	87
24	7-b	100	92	93
25	7-c	100	100	100
26	7-d	100	85	100
27	7-e	100	77	93
28	7-f	100	85	100
29	7-g	100	54	80
# Students (Trainees)		13	13	15

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 1 - MODULE 6

		SITE		
ITEM NO.	POSTTEST IDENT. #	1	3	5
1	1	100	100	100
2	2	100	100	100
3	3	100	100	100
4	4	100	100	100
5	5	100	100	100
6	6	100	100	100
7	7	87	83	99
8	8	96	93	100
9	9	100	85	73
10	10	69	87	67
11	11	49	0	42
12	12	8	0	20
13	13	54	0	40
14	14	92	92	93
15	15	50	12	80
# Students (Trainees)		13	13	15

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 2 - MODULE 1

		SITE		
ITEM NO.	POSTTEST IDENT. #	1	3	5
1	1	100	100	85
2	2	57	33	0
3	3	36	33	38
4	4	71	67	85
5	5	29	56	85
6	6	86	100	85
7	7	64	78	54
8	8	0	73	73
9	9	0	33	38
10	10-a	93	22	100
11	10-b	93	78	92
12	10-c	79	67	85
13	10-d	100	44	92
14	11	57	33	54
15	12a-1	100	100	100
16	12a-2	100	100	100
17	12a-3	50	67	85
18	12b-1	93	100	100
19	12b-2	93	100	100
20	12b-3	50	67	92
21	12c-1	100	100	100
22	12c-2	100	100	100
23	12c-3	50	67	92
# Students (Trainees)		14	9	13

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 2 - MODULE 2

ITEM NO.	POSTTEST IDENT. #	SITE 1	SITE 3	SITE 5
1	1	93	89	100
2	2	86	100	100
3	3	93	67	85
4	4	100	89	100
5	5	57	100	100
6	6	98	100	95
7	7	89	64	92
8	8	55	59	46
9	9	57	44	69
10	10	43	44	92
11	11	90	61	85
12	12	79	89	100
13	13	64	78	85
# Students (Trainees)		12	9	13

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 2 - MODULE 3

		SITE		
ITEM NO.	POSTTEST IDENT. #	1	3	5
1	1	92	89	77
2	2	92	89	92
3	3	92	100	85
4	4a	54	89	77
5	4b	100	78	92
6	4c	100	67	85
7	5a-1	0	*	85
8	5a-2	8	*	46
9	5b-1	69	*	85
10	5b-2	46	*	31
11	5c-1	46	*	31
12	5c-2	31	*	8
13	5d-1	46	*	77
14	5d-2	31	*	23
15	6a	100	100	100
16	6b	100	100	100
17	6c	92	100	92
18	6d	92	89	92
19	6e	92	100	100
20	7a	69	67	92
21	7b	100	56	69
22	8a	77	100	100
23	8b	54	78	77
24	8c	92	89	62
25	9	77	100	62
26	10a	100	78	85
27	10b	100	100	85
28	10c	69	100	100
29	10d	92	89	85
30	10e	92	100	92
31	10f	62	89	77
# Students (Trainees)		13	9	13

*Items omitted from posttest by instructor

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 2 - MODULE 4

		SITE		
ITEM NO.	POSTTEST IDENT. #	1	3	5
1	1	62	100	92
2	2	85	100	92
3	3	100	100	100
4	4	85	100	101
5	5	85	89	92
6	6	77	100	85
7	7a	77	89	46
8	7b	92	100	38
9	7c	100	100	77
10	8	92	98	94
11	9	100	89	92
12	10	62	67	69
13	11-1	69	*	77
14	11-2	77	*	69
15	11-3	62	*	69
16	11-4	77	*	69
17	11-5	77	*	54
18	11-6	77	*	69
19	12a	77	89	92
20	12b	85	44	77
21	13	62	78	77
22	14-1	85	100	100
23	14-2	46	78	85
24	14-3	85	67	100
25	14-4	62	11	92
26	14-5	77	22	85
27	15	100	100	54
28	16	100	78	54
29	17	92	89	77
30	18	77	89	85
# Students (Trainees)		13	9	13

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 2 - MODULE 5

ITEM NO.	POSTTEST IDENT. #	SITE 1	SITE 3	SITE 5
1	1a	77	70	92
2	1b	100	100	100
3	1c	85	80	92
4	1d	54	70	77
5	1e	100	100	85
6	1f	100	90	100
7	1g	100	80	92
8	2	100	90	92
9	3	100	95	96
10	4	100	60	100
11	5	85	100	77
12	6	69	50	69
# Students (Trainees)		13	10	13

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 2 - MODULE 6

ITEM NO.	POSTTEST IDENT. #	SITE		
		1	3	5
1	1	54	90	100
2	2	92	100	100
3	3	100	90	100
4	4	77	80	100
5	5a	92	100	77
6	5b	100	90	46
7	5c	69	80	92
8	6	46	60	46
9	7	0	90	92
10	8	98	95	100
11	9	31	80	92
12	10	92	100	62
13	11	92	90	100
14	12	38	60	100
15	13a	62	70	85
16	13b	62	20	85
17	13c	62	90	85
18	13d	54	80	69
19	14	62	60	62
20	15a	69	60	77
21	15b	69	20	46
22	15c	23	10	62
#Students (Trainees)		13	10	13

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 3 - MODULE 1

		SITE		
ITEM NO.	POSTTEST IDENT. #	3	*	*
1	1	56	-	-
2	2	100	-	-
3	3	56	-	-
4	4	75	-	-
5	5	44	-	-
6	6	44	-	-
7	7	83	-	-
8	8	89	-	-
9	9	84	-	-
10	10	89	-	-
11	11	78	-	-
12	12	89	-	-
13	13	100	-	-
14	14	89	-	-
15	15	74	-	-
16	16	78	-	-
17	17	22	-	-
18	18	73	-	-
19	19	75	-	-
20	20	100	-	-
21	21	100	-	-
22	22	89	-	-
#Students (Trainees)		9	-	-

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 3 - MODULE 2

ITEM NO.	POSTTEST IDENT. #	SITE 3	*	*
1	1	78	-	-
2	2	78	-	-
3	3	78	-	-
4	4	89	-	-
5	5a	56	-	-
6	5b	44	-	-
7	5c	56	-	-
8	6a	78	-	-
9	6b	22	-	-
10	6c	44	-	-
11	7a	34	-	-
12	7b	33	-	-
13	8	70	-	-
14	9	89	-	-
15	10	78	-	-
16	11	67	-	-
17	12	56	-	-
18	13	89	-	-
19	14	89	-	-
20	15	67	-	-
21	16	67	-	-
22	17	78	-	-
#Students (Trainees)		9	-	-

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 3 - MODULE 3

ITEM NO.	POSTTEST IDENT. #	SITE		
		3	*	*
1	1	73	-	-
2	2	94	-	-
3	3	91	-	-
4	4	82	-	-
5	5	77	-	-
6	6	82	-	-
7	7	100	-	-
8	8	73	-	-
9	9a	64	-	-
10	9b	64	-	-
11	9c	64	-	-
12	9d	73	-	-
13	9e	55	-	-
14	10	64	-	-
15	11	82	-	-
16	12	73	-	-
17	13	73	-	-
18	14	82	-	-
19	15	64	-	-
20	16	36	-	-
21	20[1]	82	-	-
22	21	64	-	-
23	22a	45	-	-
24	22b	73	-	-
25	22c	64	-	-
26	22d	64	-	-
27	23	73	-	-
28	24	18	-	-
#Students (Trainees)		11	-	-

*No Site Available

[1] Numbers on Posttest Skipped from 16 to 20

PERCENT CORRECT

FOR

POSTTEST ITEMS

COURSE 3 - MODULE 4

ITEM NO.	POSTTEST IDENT. #	SITE		
		3	*	*
1	1	55	-	-
2	2	37	-	-
3	3	36	-	-
4	4	68	-	-
5	5	46	-	-
6	6	18	-	-
7	7a	91	-	-
8	7b	64	-	-
9	7c	64	-	-
10	7d	18	-	-
11	7e	55	-	-
12	8	27	-	-
13	9	41	-	-
14	10	64	-	-
15	11	46	-	-
16	12	21	-	-
17	13	45	-	-
18	14	37	-	-
19	15	100	-	-
20	16	64	-	-
21	17	58	-	-
#Students (Trainees)		11		

*No site available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 3 - MODULE 5

		SITE		
ITEM NO.	POSTTEST IDENT. #	3	*	*
1	1	100	-	-
2	2	87	-	-
3	3	95	-	-
4	4	100	-	-
5	5	70	-	-
6	6	78	-	-
7	7	78	-	-
8	8	52	-	-
9	9	67	-	-
10	10a	56	-	-
11	10b	89	-	-
12	10c	78	-	-
13	11	41	-	-
14	12	100	-	-
15	13	56	-	-
16	14	44	-	-
17	15	100	-	-
18	16	78	-	-
19	17	100	-	-
20	18	78	-	-
21	19	61	-	-
22	20	28	-	-
23	21	84	-	-
#Students (Trainees)		9		

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 3 - MODULE 6

		SITE		
ITEM NO.	POSTTEST IDENT. #	3	*	*
1	1	78	-	-
2	2	95	-	-
3	3	78	-	-
4	4	44	-	-
5	5	33	-	-
6	6	78	-	-
7	7	67	-	-
8	8	45	-	-
9	9	67	-	-
10	10	67	-	-
11	11a	44	-	-
12	11b	44	-	-
13	12	67	-	-
#Students (Trainees)		9		

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 11 - MODULE 1

		SITE		
ITEM NO.	POSTTEST IDENT. #	1	5	*
1	1	71	92	-
2	2	97	69	-
3	3	93	35	-
4	4	86	69	-
5	5	86	77	-
6	6	79	46	-
7	7	93	69	-
8	8	90	69	-
9	9	79	62	-
10	10	64	69	-
11	11	86	38	-
12	12	69	33	-
13	13	81	87	-
14	14	57	54	-
15	15	53	19	-
16	16	86	100	-
17	17	50	8	-
18	18	43	8	-
19	19	79	77	-
#Students (Trainees)		14	13	

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 11 - MODULE 2

		SITE		
ITEM NO.	POSTTEST IDENT. #	1	5	*
1	1	100	86	-
2	2	97	98	-
3	3	97	93	-
4	4	78	100	-
5	5	71	79	-
6	6	64	100	-
7	7	79	71	-
8	8	71	57	-
9	9	86	71	-
10	10	93	79	-
11	11	79	55	-
12	12	81	43	-
13	13	57	57	-
14	14	29	57	-
15	15	64	50	-
16	16	43	79	-
17	17	82	57	-
#Students (Trainees)		14	14	

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 11 - MODULE 3

		SITE		
ITEM NO.	POSTTEST IDENT. #	1	*	*
1	1	95	-	-
2	2	100	-	-
3	3	82	-	-
4	4	71	-	-
5	5a	100	-	-
6	5b	100	-	-
7	5c	100	-	-
8	6	93	-	-
9	7	86	-	-
10	8	43	-	-
11	9	100	-	-
12	10	86	-	-
13	11	86	-	-
14	12	92	-	-
15	13	64	-	-
16	14	54	-	-
17	15	57	-	-
18	16	64	-	-
19	17	100	-	-
20	18	64	-	-
#Students (Trainees)		14		

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 11 - MODULE 4

		SITE		
ITEM NO.	POSTTEST IDENT. #	1	*	*
1	1	94	-	-
2	2	86	-	-
3	3	86	-	-
4	4	98	-	-
5	5	57	-	-
6	6	86	-	-
7	7a	50	-	-
8	7b	57	-	-
9	7c	43	-	-
10	7d	79	-	-
11	8	71	-	-
12	9	100	-	-
13	10	86	-	-
14	11	93	-	-
15	12	100	-	-
16	13	71	-	-
17	14	93	-	-
18	15	71	-	-
19	16	50	-	-
20	17	71	-	-
21	18	64	-	-
#Students (Trainees)		14		

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 11 - MODULE 5

		SITE		
ITEM NO.	POSTTEST IDENT. #	1	*	*
1	1	86	-	-
2	2	90	-	-
3	3a	71	-	-
4	3b	64	-	-
5	3c	41	-	-
6	3d	86	-	-
7	4a	86	-	-
8	4b	93	-	-
9	4c	53	-	-
10	5a	100	-	-
11	5b	71	-	-
12	5c	71	-	-
13	6	87	-	-
14	7	86	-	-
15	8a	86	-	-
16	8b	86	-	-
17	8c	71	-	-
18	9	64	-	-
19	10	96	-	-
20	11	71	-	-
21	12	57	-	-
22	13	86	-	-
23	14	80	-	-
24	15	57	-	-
25	16a	36	-	-
26	16b	36	-	-
27	16c	43	-	-
28	16d	50	-	-
29	17	42	-	-
30	18	43	-	-

CONTINUED

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 11 - MODULE 5

CONTINUED

		SITE		
ITEM NO.	POSTTEST IDENT. #	1	*	*
31	19	57	-	-
32	20	86	-	-
33	21	86	-	-
34	22	68	-	-
35	23	100	-	-
#Students (Trainees)		14		

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 11 - MODULE 6

ITEM NO.	POSTTEST IDENT. #	SITE 1	SITE *	SITE *
1	1a	100	-	-
2	1b	79	-	-
3	1c	86	-	-
4	1d	100	-	-
5	1e	71	-	-
6	1f	43	-	-
7	2	79	-	-
8	3a	100	-	-
9	3b	79	-	-
10	3c	71	-	-
11	3d	100	-	-
12	3e	79	-	-
13	4	79	-	-
14	5	86	-	-
15	6	93	-	-
16	7a	93	-	-
17	7b	79	-	-
18	7c	93	-	-
19	8	79	-	-
20	9	50	-	-
21	10	64	-	-
22	11	57	-	-
23	12	57	-	-
24	13	71	-	-
25	14	71	-	-
26	15	79	-	-
27	16	86	-	-
28	17	64	-	-
29	18	93	-	-
30	19a	86	-	-

CONTINUED

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 11 - MODULE 6

CONTINUED

ITEM NO.	POSTTEST IDENT. #	SITE 1	 *	 *
31	19b	79	-	-
32	19c	36	-	-
33	20	97	-	-
34	21	64	-	-
35	22	74	-	-
#Students (Trainees)		14		

*No Site Available

116

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 11 - MODULE 7

		SITE		
ITEM NO.	POSTTEST IDENT. #	1	*	*
1	1	93	-	-
2	2	95	-	-
3	3	79	-	-
4	4a	64	-	-
5	4b	79	-	-
6	4c	100	-	-
7	4d	100	-	-
8	4e	93	-	-
9	5	57	-	-
10	6	100	-	-
11	7a	86	-	-
12	7b	86	-	-
13	7c	71	-	-
14	7d	86	-	-
15	8	86	-	-
16	9	57	-	-
17	10a	64	-	-
18	10b	71	-	-
19	11a	36	-	-
20	11b	93	-	-
21	11c	50	-	-
22	12	57	-	-
23	13	93	-	-
#Students (Trainees)		14		

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 11 - MODULE 8

		SITE		
ITEM NO.	POSTTEST IDENT. #	1	*	*
1	1	93	-	-
2	2	100	-	-
3	3a	71	-	-
4	3b	100	-	-
5	3c	86	-	-
6	4	64	-	-
7	5	93	-	-
8	6a	79	-	-
9	6b	29	-	-
10	7	100	-	-
11	8	93	-	-
12	9	86	-	-
13	10	71	-	-
14	11	64	-	-
15	12	14	-	-
16	13	86	-	-
17	14	100	-	-
18	15	79	-	-
#Students (Trainees)		14		

*No Site Available

118

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 14 - MODULE 1

ITEM NO.	POSTTEST IDENT. #	SITE		
		5	*	*
1	1	64	-	-
2	2	82	-	-
3	3	64	-	-
4	4	96	-	-
5	5	91	-	-
6	6	55	-	-
7	7	45	-	-
8	8	45	-	-
9	9	36	-	-
10	10	55	-	-
11	11	55	-	-
12	12	64	-	-
13	13	55	-	-
14	14	45	-	-
15	15	55	-	-
#Students (Trainees)		11		

*No Site Available

PERCENT CORRECT

FOR

POSTTEST ITEMS

COURSE 14 - MODULE 2

		SITE		
ITEM NO.	POSTTEST IDENT. #	5	*	*
1	1a	100	-	-
2	1b	100	-	-
3	1c	100	-	-
4	1d	100	-	-
5	1e	100	-	-
6	1f	100	-	-
7	2	88	-	-
8	3	100	-	-
9	4	83	-	-
10	5a	50	-	-
11	5b	83	-	-
12	5c	92	-	-
#Student		12		

*No Site Available

120

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 14 - MODULE 3

		SITE		
ITEM NO.	POSTTEST IDENT. #	5	*	*
1	1	86	-	-
2	2	92	-	-
3	3	83	-	-
4	4	93	-	-
5	5	67	-	-
6	6	88	-	-
7	7	75	-	-
#Students (Trainees)		12		

*No Site Available

121

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 14 - MODULE 4

ITEM NO.	POSTTEST IDENT. #	SITE		
		5	*	*
1	1	81	-	-
2	2	75	-	-
3	3	94	-	-
4	4	83	-	-
5	5	75	-	-
6	6	92	-	-
7	7	81	-	-
#Students (Trainees)		12		

*No Site Available

122

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 14 - MODULE 5

		SITE		
ITEM NO.	POSTTEST IDENT. #	5	*	*
1	1	92	-	-
2	2	83	-	-
3	3	50	-	-
4	4	42	-	-
5	5	69	-	-
#Students (Trainees)		12		

*No Site Available

123

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 14 - MODULE 6

		SITE		
ITEM NO.	POSTTEST IDENT. #	5	*	*
1	1	88	-	-
2	2	82	-	-
3	3	75	-	-
4	4	72	-	-
#Students (Trainees)		12		

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 14 - MODULE 7

		SITE		
ITEM NO.	POSTTEST IDENT. #	1	3	5
	NO TEST GIVEN			

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 14 - MODULE 8

		SITE		
ITEM NO.	POSTTEST IDENT. #	5	*	*
1	1	100	-	-
2	2	100	-	-
3	3	100	-	-
4	4	91	-	-
5	5	88	-	-
6	6	82	-	-
7	7	81	-	-
#Students (Trainees)		12		

*No Site Available

126

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 14 - MODULE 9

		SITE		
ITEM NO.	POSTTEST IDENT. #	5	*	*
1	1	75	-	-
2	2	92	-	-
3	3	94	-	-
4	4	98	-	-
5	5	67	-	-
#Students (Trainees)		12		

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 15 - MODULE 1

ITEM NO.	POSTTEST IDENT. #	SITE		
		2	4	*
1	1	50	60	-
2	2	62	29	-
3	3	85	80	-
4	4a	92	82	-
5	4b	77	47	-
6	4c	85	24	-
7	4d	38	24	-
8	4e	69	29	-
9	4f	15	0	-
10	5a	77	29	-
11	5b	69	71	-
12	5c	92	100	-
13	5d	77	59	-
14	5e	62	29	-
15	5f	62	47	-
16	5g	62	41	-
17	5h	69	71	-
18	5i	100	76	-
19	6	38	12	-
20	7	43	47	-
21	8	85	59	-
22	9	58	62	-
23	10	92	45	-
24	11	54	53	-
25	12	0	0	-
26	13	0	24	-
27	14	46	24	-
28	15	54	53	-
#Students (Trainees)		13	17	

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 15 - MODULE 2

ITEM NO.	POSTTEST IDENT. #	SITE 2	SITE 4	SITE *
1	1	69	62	-
2	2	100	58	-
3	3	92	54	-
4	4	92	77	-
5	5	31	31	-
6	6	92	69	-
7	7	85	54	-
8	8	23	15	-
9	9	31	54	-
10	10	85	23	-
#Students (Trainees)		13	13	

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 15 - MODULE 3

		SITE		
ITEM NO.	POSTTEST IDENT. #	2	4	*
1	1	69	62	-
2	2	46	31	-
3	3	46	62	-
4	4	92	38	-
5	5	15	92	-
6	6	69	46	-
7	7	8	8	-
8	8a	23	8	-
9	8b	69	38	-
10	8c	8	31	-
11	8d	38	54	-
12	9a	85	62	-
13	9b	38	31	-
14	9c	31	31	-
15	10	15	38	-
16	11a	62	54	-
17	11b	23	31	-
18	11c	69	69	-
19	11d	62	62	-
20	11e	69	15	-
21	11f	23	15	-
22	11g	77	31	-
#Students (Trainees		13	13	

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 15 - MODULE 4

ITEM NO.	POSTTEST IDENT. #	SITE		
		2	4	*
1	1	62	54	-
2	2	27	39	-
3	3	23	31	-
4	4	54	92	-
5	5	23	62	-
6	6	38	69	-
7	7a	69	92	-
8	7b	31	31	-
9	7c	62	23	-
10	8	69	92	-
11	9	38	31	-
12	10	15	92	-
13	11	69	62	-
14	12	23	77	-
15	13	35	54	-
16	14	15	62	-
17	15	23	89	-
18	16	8	100	-
19	17	23	92	-
20	18	19	85	-
21	19	31	100	-
22	20	12	69	-
23	21	31	77	-
24	22	4	85	-
25	23	12	100	-
#Students (Trainees)		13	13	

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 15 - MODULE 5

		SITE		
ITEM NO.	POSTTEST IDENT. #	2	4	*
1	1	79	67	-
2	2	36	69	-
3	3	92	58	-
4	4	69	83	-
5	5	85	92	-
6	6	77	92	-
7	7	23	58	-
8	8a	62	92	-
9	8b	62	83	-
10	8c	46	83	-
#Students (Trainees)		13	12	

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 15 MODULE 6

ITEM NO.	POSTTEST IDENT. #	SITE 2	SITE 4	SITE *
1	1	83	92	-
2	2	58	77	-
3	3	75	85	-
4	4	83	92	-
5	5	67	46	-
6	6	67	62	-
7	7a	50	0	-
8	7b	67	92	-
9	7c	67	92	-
10	7d	83	100	-
11	7e	75	92	-
12	7f	83	100	-
13	8	83	0	-
14	9	58	54	-
15	10	92	31	-
16	11	67	38	-
17	12	17	0	-
18	13	25	69	-
19	14	83	100	-
20	15	92	100	-
21	16	42	73	-
22	17	100	85	-
23	18	100	92	-
24	19	58	46	-
#Students (Trainees)		12	13	

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 15 - MODULE 7

		SITE		
ITEM NO.	POSTTEST IDENT. #	2	4	*
1	1	75	92	-
2	2	58	38	-
3	3	25	12	-
4	4	50	38	-
5	5	83	38	-
6	6	8	0	-
7	7	83	92	-
8	8a	83	38	-
9	8b	8	8	-
10	8c	75	69	-
11	8d	50	46	-
12	8e	75	62	-
13	8f	58	54	-
14	8g	100	92	-
15	8h	75	92	-
16	9	83	77	-
17	10	67	97	-
18	11	75	46	-
#Students (Trainees)		12	13	

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 15 - MODULE 8

		SITE		
ITEM NO.	POSTTEST IDENT. #	2	4	*
1	1	30	92	-
2	2	0	75	-
3	3	20	8	-
4	4	30	25	-
5	5	30	17	-
6	6	36	50	-
7	7	10	46	-
8	8	47	67	-
9	9	40	42	-
10	10	83	81	-
11	11	40	58	-
12	12	80	83	-
13	13	50	25	-
#Students (Trainees)		10	12	

*No Site Available

PERCENT CORRECT

FOR

POSTTEST ITEMS

COURSE 27 - MODULE 1

ITEM NO.	POSTTEST IDENT. #	SITE 6	SITE 7	SITE *
1	1	73	100	-
2	2	55	100	-
3	3	55	75	-
4	4	55	88	-
5	5	73	100	-
6	6	73	88	-
7	7	55	88	-
8	8	82	88	-
9	9a	55	75	-
10	9b	73	100	-
11	9c	55	88	-
12	9d	45	75	-
13	10	64	69	-
14	11	52	75	-
15	12	30	79	-
16	13	66	81	-
17	14	23	69	-
18	15	39	100	-
19	16	18	100	-
20	17	50	94	-
21	18	27	75	-
22	19	82	100	-
23	20	9	25	-
#Students (Trainees)		11	8	

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 27 - MODULE 2

		SITE		
ITEM NO.	POSTTEST IDENT. #	6	7	*
1	1	91	86	-
2	2	91	86	-
3	3a	82	100	-
4	3b	73	100	-
5	3c	91	100	-
6	3d	55	86	-
7	4	61	90	-
8	5	36	57	-
9	6	82	89	-
10	7a	64	86	-
11	7b	91	100	-
12	7c	91	86	-
13	7d	73	100	-
14	8	70	100	-
15	9a	91	86	-
16	9b	73	100	-
17	9c	73	29	-
18	10	76	100	-
19	11a	55	86	-
20	11b	64	86	-
21	11c	27	43	-
22	12	7	71	-
#Students (Trainees)		11	7	-

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 27 - MODULE 3

		SITE		
ITEM NO.	POSTTEST IDENT. #	6	7	*
1	1	82	100	-
2	2	79	89	-
3	3	48	55	-
4	4	91	60	-
5	5	18	20	-
6	6	73	47	-
7	7	73	80	-
8	8	76	96	-
9	9a	9	40	-
10	9b	9	20	-
11	10	45	60	-
12	11	64	65	-
13	12	55	100	-
14	13	45	100	-
15	14	45	20	-
16	15a	0	40	-
17	15b	9	40	-
18	16	0	0	-
19	17	0	0	-
20	18a	0	20	-
21	18b	0	0	-
22	18c	0	0	-
23	18d	0	0	-
#Students (Trainees)		11	5	

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 27 - MODULE 4

		SITE		
ITEM NO.	POSTTEST IDENT. #	6	7	*
1	1	64	50	-
2	2	91	100	-
3	3a	55	0	-
4	3b	55	50	-
5	4	55	50	-
6	5	76	100	-
7	6	27	50	-
8	7	64	100	-
9	8	45	50	
10	9	45	50	-
11	10	45	0	-
12	11a	64	100	-
13	11b	36	100	-
14	11c	18	100	-
15	11d	36	100	-
16	11e	55	100	-
17	12a	27	100	-
18	12b	36	100	-
19	12c	36	100	-
20	12d	36	100	-
21	12e	36	100	-
22	12f	36	100	-
23	13	28	25	-
24	14	9	0	-
25	15	18	0	-
#Students (Trainees)		11	2	

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 27 - MODULE 5

ITEM NO.	POSTTEST IDENT. #	SITE 6	SITE 7	SITE *
1	1a	100	100	-
2	1b	82	100	-
3	1c	18	67	-
4	1d	27	100	-
5	1e	27	100	-
6	1f	36	100	-
7	1g	55	100	-
8	1h	36	100	-
9	2	76	78	-
10	3	73	56	-
11	4	100	100	-
12	5	100	100	-
13	6	100	100	-
14	7	100	100	-
15	8	100	100	-
16	9	100	100	-
17	10	100	100	-
18	11	100	100	-
19	12	100	100	-
20	13	100	100	-
21	14	100	100	-
22	15	100	100	-
23	16a	28	17	-
24	16b	45	33	-
25	17	36	33	-
26	18	0	0	-
27	19	9	33	-
28	20	18	0	-
29	21	18	0	-
#Students (Trainees)		11	3	

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 27 - MODULE 6

		SITE		
ITEM NO.	POSTTEST IDENT. #	6	7	*
1	1a	100	100	-
2	1b	55	100	-
3	1c	73	100	-
4	1d	91	100	-
5	1e	91	100	-
6	2	45	0	-
7	3a	45	0	-
8	3b	27	0	-
9	4	43	25	-
10	5a	36	0	-
11	5b	0	0	-
12	5c	18	0	-
13	5d	27	0	-
14	5e	64	0	-
15	6	73	100	-
16	7	82	0	-
17	8	91	0	-
18	9	64	0	-
19	10	91	0	-
20	11	82	100	-
21	12	91	0	-
22	13	91	0	-
23	14	82	100	-
24	15	91	0	-
25	16	91	0	-
26	17	100	100	-
27	18	100	0	-
28	19	55	0	-
29	29	9	0	-
#Students (Trainees)		11	1	

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 27 - MODULE 7

		SITE		
ITEM NO.	POSTTEST IDENT. #	6	7	*
1	1a	90	100	-
2	1b	90	100	-
3	1c	80	100	-
4	1d	80	100	-
5	2a	20	50	-
6	2b	0	0	-
7	2c	0	0	-
8	3	10	33	-
9	4a	40	50	-
10	4b	0	0	-
11	4c	0	0	-
12	5	8	33	-
13	6a	0	50	-
14	6b	0	50	-
15	6c	10	50	-
16	7a	10	50	-
17	7b	0	50	-
18	7c	10	50	-
19	8	30	0	-
20	9	20	50	-
#Students (Trainees)		10	2	

*No Site Available

PERCENT CORRECT
FOR
POSTTEST ITEMS

COURSE 27 - MODULE 8

ITEM NO.	POSTTEST IDENT. #	SITE 6	SITE 7	SITE *
1	1	50	100	-
2	2	40	100	-
3	3	30	50	-
4	4	20	50	-
5	5	6	50	-
6	6	0	0	-
7	7	12	33	-
8	8	20	100	-
9	9	20	50	-
10	10	20	50	-
11	11	30	100	-
12	12	10	50	-
#Students (Trainees)		10	2	

*No Site Available

APPENDIX F

COURSE MODULES AND OBJECTIVES

COURSE 26 NONDESTRUCTIVE EXAMINATION (NDE) TECHNIQUES I

Upon completion of this course, the student shall be able to describe the principles of operation, identify equipment components, state the applicability, briefly describe how to interpret the results, and give the pros and cons of each of the following NDE techniques: radiography, penetrant, visual, leak, and hydrostatic. The student shall be able to pass appropriate Level II SNT-TC-1A certification tests.

Module 26-1 - Visual Tests - Upon completion of this module, the student shall be able to describe the principles of operation, identify equipment components, state the applicability, briefly describe how to interpret the results, and give the pros and cons of the visual method.

Module 26-2 - Leak Tests - Upon completion of this module, the student shall be able to describe the principles of operation, identify euqipment components, state the applicability, briefly describe how to interpret the results, and give the pros and cons of the leak method.

Module 26-3 - Hydrostatic Tests - Upon completion of this module, the student shall be able to describe the principles of operation, identify equipment components, state the applicability, briefly describe how to interpret the results, and give the pros and cons of the hydrostatic method.

Module 26-4 - Liquid Penetrant Tests - Upon completion of this module, the student shall be able to describe the principles of operation, identify equipment components, state the applicability, briefly describe how to interpret the results, and give the pros and cons of the liquid penetrant method.

Module 26-5 - Fundamentals of Radiography - Upon completion of this module, the student shall be able to describe the principles of operation, identify equipment components, state the applicability and give the pros and cons of the radiographic method.

Module 26-6 - Radiography Inspection - Upon completion of this module, the student shall be able to properly choose and mount the film, expose the source, and develop the film for a typical gamma radiography inspection of a flat metal plate, being sure to observe proper safety precautions and regulations.

Module 26-7 - Radiographic Specifications and Code Requirements - Upon completion of this module, the student shall be able to interpret radiographic film and compare the results with specifications and code requirements.

COURSE 27 METROLOGY

Upon completion of this course, the student shall be able to describe basic fundamentals of the science of measurement (i.e., metrology), including units of measurement, measurement equipment, measurement errors, and calibration, and perform dimensional measurements using several types of instruments, calibrate the instruments, and interpret the results in terms of possible errors.

Module 27-1 - Fundamentals of Metrology - Upon completion of this module, the student shall be able to describe basic fundamentals of metrology, including units of measurement, measurement equipment, measurement errors, and calibration. This module provides an introduction to the other modules in this course.

Module 27-2- Fixed Gages, Dividers, Calipers and Micrometers - Upon completion of this module, the student shall be able to read and interpret dimensional data to manufacturers' tolerance from the following equipment: micrometers, calipers, go/no-go gages, ring gages, and thread gages.

Module 27-3 - Gage Blocks, Mechanical Comparators and Electronic Comparators - Upon completion of this module, the student shall be able to read and interpret dimensional data to manufacture tolerances using comparative measurement techniques.

Module 27-4 - Angle Measurement Instruments, Optical Projectors, and Surface Texture Gages - Upon completion of this module, the student shall be able to read and interpret dimensional data to manufacturer tolerances from the following equipment: universal bevel protractor, sine bar, optical projector and surface texture gages.

Module 27-5 - Tolerancing - Upon completion of this module, the student shall be able to describe and apply regardless of feature size and maximum material condition tolerancing principles to goemetric characteristics.

Module 27-6 - Calibration - Upon completion of this module, the student shall be able to describe the processes used to calibrate a given test instrument, including on-site and off-site standards, and calibrate the measurement equipment used in Modules 27-2 and 27-3.

Module 27-7 Statistical Techniques in Metrology - Upon completion of this module, the student shall be able to describe sampling methods, including basic statistics used to determine acceptability of a given product sample. This module is a continuation of Module 14-9.

Module 27-8 - The Total Measurement System - Upon completion of this module, the student shall be able to describe the concepts associated with the total measurement system including inspectability, staging, inspection planning, and inspection instructions.

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COURSE 28 WELDING INSPECTION

Upon completion of this course, the student shall be able to inspect structural steel welding in accordance with ANSI N45.2.5.

Module 28-1 - Welding Fundamentals and Procedures - Upon completion of this module, the student shall be able to briefly describe the basic fundamental processes of welding structural steel, the various types of welding processes, and the basic equipment of each process.

Module 28-2 - Shielded Metal Arc and Oxyacetylene Welding - Upon completion of this module, the student shall be able to describe the techniques and procedures used in shielded metal arc welding and oxyacetylene welding, and characteristic defects, their causes, and prevention as associated with these processes.

Module 28-3 - Tungsten Inert Gas (TIG), Metal Inert Gas (MIG) and Submerged Arc Welding - Upon completion of this module, the student shall be able to describe the techniques and procedures used in gas tungsten arc welding (TIG), gas metal arc welding (MIG), and submerged arc welding, and characteristic defects, their causes and prevention as associated with these processes.

Module 28-4 - Weld Joint Verification - Upon completion of this module, the student shall be able to describe the strength of various types, weld preparation, fit-up, cleanliness, and advantages and disadvantages of each type; and complete an actual weld joint verification inspection.

Module 28-5 - Qualifications - Upon completion of this module, the student shall be able to state the purposes of qualifications of welding procedures and welders and to describe the variables affecting qualification, typical qualification tests, and qualification techniques.

Module 28-6 - Process Controls - Upon completion of this module, the student shall be able to describe the in-process inspections for joint fit-up, preheat and interpass temperatures, distortion control, and cleaning and grinding requirements; describe verifications of compliance with welding procedures; and perform an actual in-process inspection.

Module 28-7 - Acceptance Inspection - Upon completion of this module, the student shall be able to describe acceptance inspection of completed welds, correlate weld defects with best inspection method, and describe factors affecting the point in time for performing acceptance inspections.

Module 28-8 - Filler Material Control - Upon completion of this module, the student shall be able to describe the storage, handling, inspection, classification and documentation of filler material; and complete an actual filler material inspection.

Module 28-9 - Weld Repair Control - Upon completion of this module, the student shall be able to describe how weld defects are repaired and the controls placed on the repair process.

Module 28-10 - Records - Upon completion of this module, the student shall be able to distinguish types of weld records and to state the purpose and describe applications of qualification records, material test reports, weld joint records, and nondestructive examination records.

COURSE 29 CIVIL/STRUCTURAL INSPECTION

Upon completion of this course, the student shall be able to inspect structural concrete and structural steel during nuclear power plant consturction in accordance with ANSI N45.2.5.

Module 29-1 - Inspection of Construction Operations - Upon completion of this module, the student shall be able to briefly describe the operations and processes that are performed, and the inspections of such operations and processes during nuclear power plant construction. This module gives an introduction to the entire course.

Module 29-2 - Structural Steel Materials, Installation, and Inspection - Upon completion of this module, the student shall be able to describe the techniques and procedures for storing, handling and erection of structural steel, and to perform a simulated inspection of the storing, handling, and erection of structural steel for a nuclear power plant, being sure to follow the correct codes and standards, and using correct documentation.

Module 29-3 - Concrete Materials - Upon completion of this module, the student shall be able to describe the materials used for concrete, the effect of material variation on concrete strength, material code requirements and measuring and test equipment; and use the measuring and test equipment to inspect concrete materials according to code requirements using correct documentation.

Module 29-4 - Concrete Preparation, Production, Placement and Finishing - Upon completion of this module, the student shall be able to describe the techniques and processes used for concrete production, preparations for concrete placement and concrete placement, and perform the inspection of such according to code requirements using documentation.

Module 29-5 - Concrete Testing and Inspection - Upon completion of this module, the student shall be able to describe the techniques and processes used for concrete placement and finishing and perform the inspection of such according to code requirements using correct documentation.

Module 29-6 - Pre-Stressed Concrete Materials, Fabrication, and Inspection - Upon completion of this module, the student shall be able to briefly describe the techniques and processes used for the fabrication and installation of concrete; and perform the inspection of such according to code requirements using correct documentation, including, but not limited to, these measuring devices: thermometers, balances, scales, air entrainment meters, humidity meters, volumetric buckets, field soil density measuring devices, pressure gages, and torque wrenches.

COURSE 30 MECHANICAL INSPECTION

Upon completion of this course, the student shall be able to inspect mechanical equipment and systems during nuclear power plant construction in accordance with ANSI N45.2.8.

Module 30-1 - Pump Inspection - Upon completion of this module, the student shall be able to perform pre-installation, installation, and pre-operational inspections and tests on pumps according to ANSI N45.2.8; and keep correct documentation.

Module 30-2 - Pump Functional Testing - Upon completion of this module, the student shall be able to perform cold and hot functional inspections and tests of pumps according to ANSI N45.2.8; and keep correct documentation.

Module 30-3 - Valve Inspection - Upon completion of this module, the student shall be able to perform pre-installation, installation, pre-operation, and functional inspections and tests of valves according to ANSI N45.2.8; and keep correct documentation.

Module 30-4 - Piping Inspection - Upon completion of this module, the student shall be able to perform pre-installation, installation, pre-operation, and functional inspections and tests of piping according to ANSI N45.2.8; and keep correct documentation.

Module 30-5 - Surface Cleaning Inspection - Upon completion of this module, the student shall be able to inspect cleaning activities and surfaces for cleanings as required by ANSI N45.2.8 and according to ANSI N45.2.1; and keep correct documentation.

Module 30-6 - Protective Coating Inspection - Upon completion of this module, the student shall be able to inspect protective coatings according to ANSI N101.4; and keep correct documentation.

Module 30-7 - Pressure Vessel Inspection - Upon completion of this module, the student shall be able to describe the processes and methods used to inspect pressure vessels.

Module 30-8 - Rotating Equipment Inspection - Upon completion of this module, the student shall be able to describe the processes and methods used to inspect rotating equipment, including fans, motors, blowers, turbines, and generators.

COURSE 31 QUALITY ASSURANCE PRACTICES

Upon completion of this course, the student shall be able to describe and perform various quality assurance procedures usually done by quality assurance/quality control technicians and describe general aspects of a company quality assurance program.

Module 31-1 - Overall Quality Assurance Program - Upon completion of this module, the student shall be able to describe generally the overall quality assurance program of nuclear power plant A-E's, constructors, component manufacturers, and operating utilities and compare the programs of several companies.

Module 31-2 - Vendor Qualification - Upon completion of this module, the student shall be able to describe the procedure for qualifying component vendors according to codes and regulations and perform a typical vendor qualification as a class project.

Module 31-3 - Receiving Inspection - Upon completion of this module, the student shall be able to describe a system for received material and actually perform a sample inspection according to ANSI N45.2.2.

Module 31-4 - Identification, Storage and Handling of Components, Parts and Materials - Upon completion of this module, the student shall be able to describe a system for identification, storage and handling of parts and materials and actually perform a sample inspection according to ANSI N45.2.2

Module 31-5 - Nonconforming Materials - Upon completion of this module, the student shall be able to describe a system for identification, storage, handling and disposal of nonconforming materials and actually perform work such.

Module 31-6 - Certification and Qualification of Quality Control Inspectors - Upon completion of this module, the student shall be able to describe certification of inspection, examination, and testing personnel for nuclear power plants and take a number of typical tests.

Module 31-7 - Auditing for Quality Assurance - Upon completion of this module, the student shall be able to describe how and why auditing is conducted for nuclear power plants and perform audits on previous inspections conducted by classmates according to ANSI N45.2.9.

Module 31-8 - Document Handling, Storage and Retrieval for Quality Assurance - Upon completion of this module, the student shall be able to describe a system for the handling, storage and retrieval of quality assurance documents and actually handle, store and retrieve sample quality assurance documents according to ANSI N45.2.9.

COURSE 32 NONDESTRUCTIVE EXAMINATION (NDE) TECHNIQUES II

Upon completion of this course, the student shall be able to describe the principles of operation, identify equipment components, state the applicability, briefly describe how to interpret the results, and give the pros and cons of each of the following NDE techniques: ultra-sonic, magnetic particle and eddy current testing. The student shall be able to pass appropriate Level II (SNT-TC-1A) certification tests.

Module 32-1 - Fundamentals of Ultrasonic Testing - Upon completion of this module, the student shall be able to describe the principles of operation, identify equipment components, state the applicability, and give the pros and cons of the ultrasonic method.

Module 32-2 - Operation of Ultrasonic Test Equipment - Upon completion of this module, the student shall be able to operate ultrasonic testing equipment and interpret the results.

Module 32-3 - Fundamnetals of Magnetic Particle Testing - Upon completion of this module, the student shall be able to describe the principles of operation, identify equipment components, state the applicability and give the pros and cons of the magnetic particle method.

Module 32-4 - Operation of Magnetic Particle Test Equipment - Upon completion of this module, the student shall be able to operate magnetic particle equipment and interpret the results.

Module 32-5 - Fundamentals of Eddy Current Testing - Upon completion of this module, the student shall be able to describe the principles of operation, identify equipment components, state the applicability and give the pros and cons of the eddy current method.

Module 32-6 - Operation of Eddy Current Test Equipment - Upon completion of this module, the student shall be able to operate eddy current equipment and interpret the results.

APPENDIX G

ADVISORY COMMITTEE MEMBERS

1. Mr. Walter Bryant, QA Manager
Niagara Mohawk Power Corporation
300 Erie Boulevard, West
Syracuse, New York 13202

2. Mr. David Cook
1235 Manorway Drive
Florence, South Carolina 29501

3. Dr. Monte Davis, Director
Neely Nuclear Research Center
Georgia Institute of Technology
Atlanta, Georgia 30332

4. Mr. Michael Morris
Radiation Services
P.O. Box 2985
Ripley, Oklahoma 74062

5. Mr. Martin McIntyre
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Greenville, South Carolina 29615

6. Mr. David O'Brien
Standards and Testing Facility
Steam Production Department
Duke Power Company
422 South Church Street
Charlotte, North Carolina 28242

7. Mr. Robert Wathen, QA Manager
Gould, Incorporated
2002 Bethel Road
Finksburg, Maryland 21048

8. Mr. Harold Young
Chief, Institutional Program Branch
Educational Program Division
DOE
400 First Street, NW
Washington, D.C. 20545

APPENDIX H

NONDESTRUCTIVE EXAMINATION TOPICS

Nondestructive Examinations

MAJOR TOPIC	COVERED BY	FREQUENCY OF USE
1. Visual Tests	Module 26-1	Often
2. Leak Tests	Module 26-2	Often
3. Hydrostatic Tests	Module 26-3	Often
4. Liquid Penetrant Tests	Module 26-4	Often
5. Raidography	Module 26-5, 26-6 & 26-7	Often
6. Ultrasonic Tests	Module 32-1, & 32-2	Often
7. Magnetic Particle Tests	Module 32-3, & 32-4	Often
8. Eddy Current Tests	Module 32-5, & 32-6	Sometimes
9. Beta Testing	----	Sometimes
10. Neutron Radiography	----	Often at fuel processing plants infrequent elsewhere
11. Electrical Testing	----	Often
12. Inservice Inspection of Concrete	----	Sometimes
13. Instrumentation and Control System Calibration	----	Often

MAJOR TOPIC	COVERED BY	FREQUENCY OF USE
14. Acoustic Emission	----	*Seldom
15. Vibration Analysis	----	*Seldom
16. Halography	----	Sometimes
17. Microwave Tests	----	Sometimes
18. Sodium Tests	----	Sometimes

* = use is becoming more frequent as developments better quantify the test method.

Inspection Agencies

1. Role of Authorized Inspector	----	Often
2. Role of American Nuclear Insurers (formerly NEL-PIA) Representative	----	Often

APPENDIX I

ELECTRICAL INSPECTION TOPICS

ELECTRICAL INSPECTION COURSE

RECOMMENDED TOPICS

1. Introduction to Electrical Inspection

2. Definitions of Electrical and Electronic Terms

3. Pre-Installation Verification

    a. identification
    b. processes and procedures
    c. physical condition
    d. work site conditions

4. Installation

    a. process and procedure control
    b. inspection of work area and jobs in progress
    c. installation checks
    d. care and handling of test equipment

5. Pre-Operational Testing and Inspection

    a. operational readiness and completeness
    b. pre-operational testing

6. Documentation

    a. lifetime quality assurance records
    b. non-permanent quality assurance records

7. Introduction to reading and using pipe and instrument drawings (P.&I.D.'s), control and instrument drawings (C.&I.D.'s), wiring diagrams (W.D.'s) and electrical schematic diagrams.

8. Description and use of various types of Electrical Switchgear.

9. Techniques of routing cable and conduct wiring in the plant emphasing separation techniques for electrical buses and plant loads.

10. Discussion of Electrical Standards emphasizing NEMA (National Electrical Manufacturers Association), ANSI (American National Standards Institute), and UL (Underwriters Laboratories) standards and codes.

11. Basic description of the Alternating Current (AC) and the Direct Current (DC) systems employed at a nuclear power station.

12. Description of plant arrangement of Service Buses and Engineered Safety Features (ESF) Buses in the plant.

13. Description of the Diesel Generator System to supply power to the Engineered Safety Features (ESF) Systems in the plant in case of emergency conditions.

14. Description of Batteries and Battery charger powered systems used to supply control power and operating power to plant components and standby equipment.

15. Description of Motors; Motor Operators; Motor Control Centers (M.C.C.'s); Heating, Ventilating and Air Conditioning Systems (HVAC); Solenoids; Interlocks and Pump Drive Systems employed in a typical nuclear power station.

16. Description of the Main Electrical Generator; Generator Control System and Auxiliary Power System used in the nuclear power station.

APPENDIX J

NUCLEAR TECHNOLOGY PROMOTIONAL BROCHURE

GENERAL PHYSICS CORPORATION

1000 CENTURY PLAZA
COLUMBIA, MARYLAND 21044
301-730-4055 — 301-953-3340

July 1, 1978

TO :

FROM : Chester F. Kupiec, Project Director
Nuclear Quality Assurance/Quality Control Technology
General Physics Corporation

SUBJECT: Dissemination of Informational Leaflet on Nuclear Technology Series

Over the last several years, the U.S. Office of Education has undertaken the development of teaching/learning material in modular form. The enclosed leaflet describes the Nuclear Technology Series which is nearing completion.

General Physics Corporation is currently under contract to develop the modules for technical courses in the second year of the two-year postsecondary curriculum for Nuclear Quality Assurance/Quality Control (QA/QC) Technology. The QA/QC project will be completed in March, 1979. An earlier contract by the Office of Education developed the modules for the Nuclear Plant Operator Trainee program. The 16 courses consisting of a total of 114 modules for this training program along with program planning guides are now available for use (see leaflet for availability from Technical Education Research Center). The modules/courses for the remaining three nuclear technologies are proposed to be developed under a project to be funded in the near future. These technologies are: Radiation Protection, Materials Processing, and Instrumentation and Control.

The first-year technical courses developed for the Nuclear Plant Operator Trainee program are common to all technologies. General Physics is field testing these courses and their modules in three postsecondary and industry training programs. The course materials are developed in modular form to provide the utmost flexibility in both educational institution and industrial training programs so that specific training needs and requirements can be met. They are designed for use by both student and instructor. Each course consists of an average of seven or eight modules per course.

Please share the information in the leaflet with other potentially interested persons in your organization. Additional copies of the leaflet on the Nuclear Technology Series are available upon request from General Physics Corporation.

Yours truly,

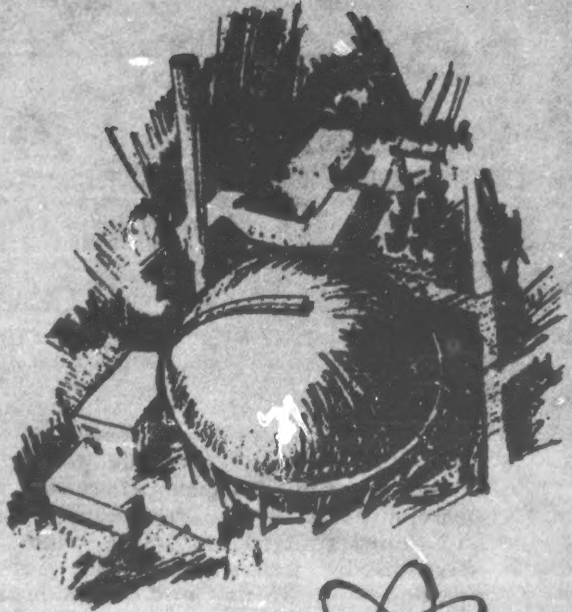
GENERAL PHYSICS CORPORATION
Chester F. Kupiec
Chester F. Kupiec, Project Director

SPECIALTY COURSES FOR NUCLEAR TECHNOLOGY CURRICULA

Course No.	Technical Course Title	Number of Modules	Preparatory Programs — Nuclear Technicians: Nuclear Plant Operator Trainee Preparation	Radiation Protection Technology	Nuclear Materials Processing Technology	Nuclear Quality Assurance/Quality Control Technology	Nuclear Instrumentation and Control Technology
1	Radiation Physics	6	1	1	1	1	1
2	Radiation Protection I	6	2	2	2	2	2
3	Principles of Process Instrumentation	8	2		3	2	3
4	Heat Transfer and Fluid Flow	9	3				
5	Introduction to Nuclear Systems	6	4	3		4	4
6	Instrumentation and Control of Reactors and Plant Systems	5	5				5
7	Reactor Operations	7	6				
8	Reactor Safety	5	6				
9	Reactor Auxiliary Systems	4	6				
10	Power Plant Systems	9	5				
11	Radiation Detection and Measurement	8	2	2	2	2	2
12	Reactor Physics	8	4				4
13	Power Plant Chemistry	7	5				
14	Introduction to Quality Assurance/Quality Control	9	3	3	3	3	3
15	Metallurgy and Metals Properties	8	3		4	3	
16	Mechanical Component Characteristics and Specifications	8	4			4	
17	Radiation Protection II	5		4	4		
18	Radiological Emergencies	7		4			
19	Radiation Shielding	6		5			
20	Radiation Monitoring Techniques	7		5	5		
21	Radioactive Materials Disposal and Management	7		5			
22	Advanced Radionuclide Analysis	7		6			
23	Nuclear Chemical Processes	6			5		
24	Nuclear Systems and Safety	7			6		
25	Radioactive Material Handling Techniques	8			6		
26	Nondestructive Examination (NDE) Techniques I	7				4	
27	Metrology	8			2	3	
28	Welding Inspection	11				5	
29	Civil/Structural Inspection	8				5	
30	Mechanical Inspection	9				5	
31	Quality Assurance Practices	8				6	
32	Nondestructive Examination (NDE) Techniques II	6				5	
33	Quality Assurance and Reliability	6					5
34	Advanced Nuclear Instrumentation	4					6

Above numbers denote suggested school quarter for each course.

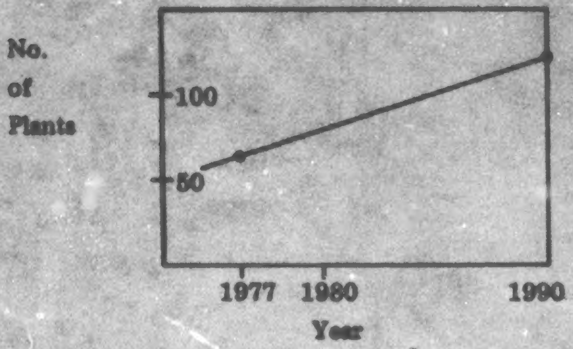
NUCLEAR TECHNOLOGY



Comprehensive Training Programs
for
Nuclear Technicians

NEED FOR NUCLEAR TECHNICIANS

- The number of nuclear power plants is rapidly increasing. Trained technicians will be needed to staff these plants.



- Safety is foremost. The safe generation of power with negligible effect on the environment is assured by proper design and construction of plants and by operation by trained individuals. Formal personnel training and qualification requirements must be met by individuals assigned to nuclear power plants.
- Requirements for personnel training are extensive. Due to the diverse technologies employed in a nuclear power plant, multi-year training programs are needed to equip individuals to successfully qualify in one or more technician categories.

EMPLOYMENT OPPORTUNITIES

- Nuclear Utilities
- Power Plant Construction Contractors
- Nuclear Component Manufacturers
- Regulatory Agencies
- Related Fields of Nuclear Medicine, Horticulture and Geology
- Nuclear Research

REQUIRED TECHNOLOGIES

- Nuclear Plant Operator Trainee — Manipulates plant controls in a safe manner utilizing normal and emergency operating procedures.
- Radiation Protection Technician — Minimizes exposure and contamination through a variety of surveys, tests, evaluations, and procedures to protect against radiation exposure.
- Nuclear Instrumentation Technician — Maintains a wide variety of instrumentation and process control systems in good operating order.
- Nuclear Quality Assurance/Quality Control Technician — Performs a variety of inspections, tests and evaluations to insure and confirm compliance with technical requirements.
- Nuclear Material Processing Technician — Ensures safe handling, processing, and storage of nuclear materials.

CURRICULA MATERIALS

(see chart on reverse side)

The U.S. Office of Education has contracts underway which are developing the Nuclear Plant Operator Trainee and the Nuclear Quality Assurance/Quality Control Technician curricula. (It is anticipated that the development of the other three curricula will follow.) The curricula consist of 34 courses for the five technical occupations.

- Adaptability — The curricula are designed for two-year postsecondary educational programs, as well as industry and adult training programs. The materials consist of 241 modules for the five curricula, thus providing great flexibility and adaptability in varied training settings.
- Availability — Information on individual modules (114) for the Nuclear Plant Operator Trainee program is available from: Technical Education Research Center, 4201 Lake Shore Drive, Waco, Texas 76710.

For information on the other technical curricula, clip and mail the coupon below to:

William Berndt
Curriculum Development Branch
Division of Research & Demonstration
BOAE, U.S. Office of Education
Washington, DC 20202

Please send information on: (Check)
☐ Radiation Technology
☐ Nuclear Materials Processing Technology
☐ Nuclear QA/QC Technology
☐ Nuclear Instrumentation & Control Technology

Name ____________________
Organization ____________________
Street ____________________
City ____________________
State ____________________ Zip __________